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ABSTRACT

This report was commissioned in response to concerns expressed about the gap between institutional digital library initiatives and the products offered by library systems vendors. The study analyzes from the perspective of libraries the strategies, visions, and products that vendors of integrated library systems are offering as solutions. Case studies are provided of four different types of libraries that have installed commercially available systems to provide a snapshot of the extent to which these systems met the needs of the institutions. Vendor profiles are then offered for 12 companies, including a brief summary for each, and information on primary products and services, primary markets, overall strategy, product tools and features, adaptability to library needs, strategy for networked information, product development infrastructure, acquisitions and strategic partnerships, corporate organization and offices, and a financial statement. (AEF)

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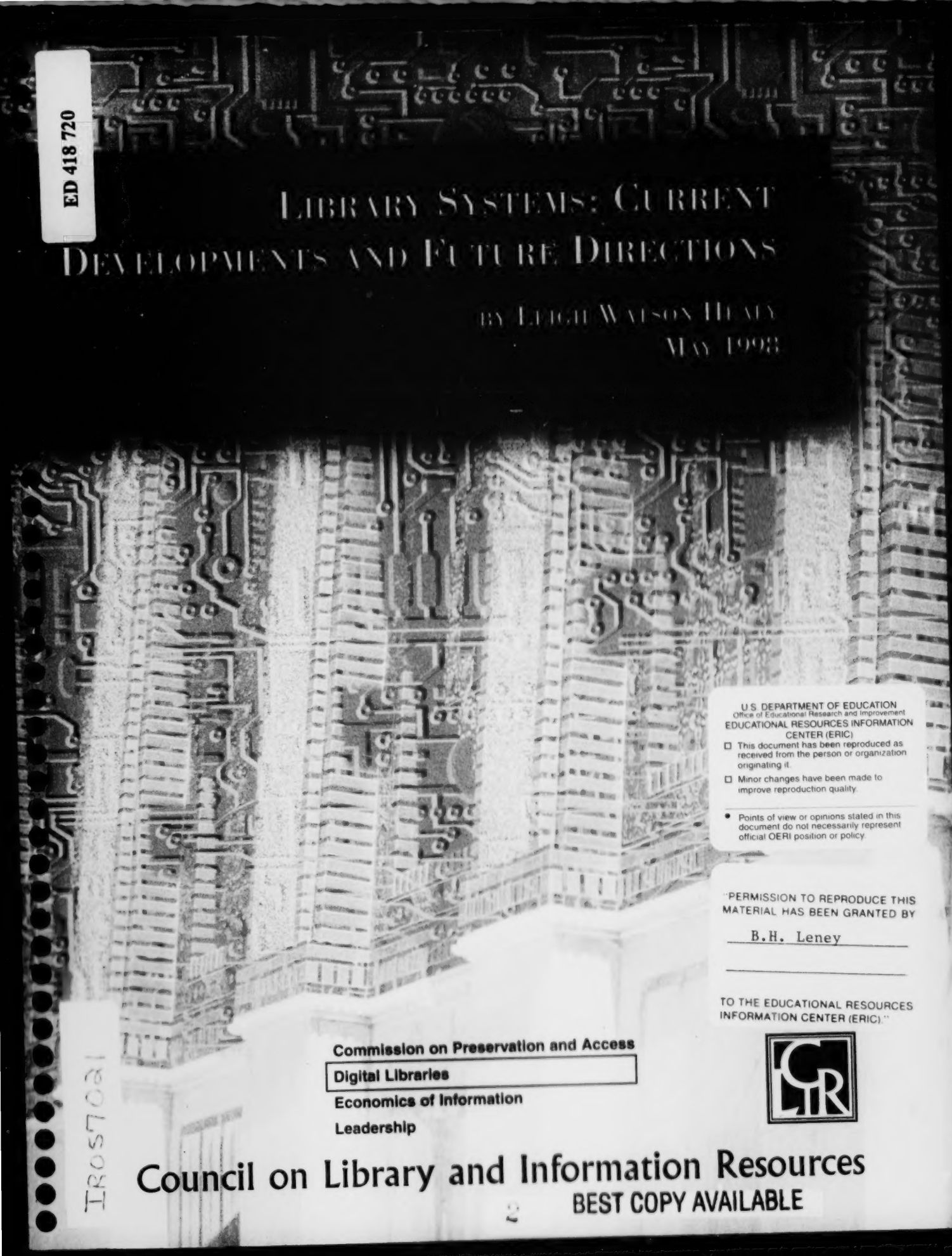
Library Systems: Current Developments and Future Directions

by Leigh Watson Healy

May 1998



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by Leigh Watson Healy
May 1998

Council on Library and Information Resources

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COUNCIL ON LIBRARY AND INFORMATION RESOURCES

The Council on Library and Information Resources (CLIR) grew out of the 1997 merger of the Commission on Preservation and Access and the Council on Library Resources. CLIR identifies the critical issues that affect the welfare and prospects of libraries and archives and the constituencies they serve, convenes individuals and organizations in the best position to engage these issues and respond to them, and encourages institutions to work collaboratively to achieve and manage change. CLIR maintains four current programs: the Commission on Preservation and Access, Digital Libraries, the Economics of Information, and Leadership.

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Preface

The Council on Library and Information Resources commissioned this report in response to concerns expressed to us about the gap between institutional digital library initiatives and the products offered by library systems vendors. Leigh Watson Healy, in this commissioned study, analyzes from the perspective of libraries the strategies, visions, and products that vendors of integrated library systems are offering as solutions. She has also developed case studies of different types of libraries that have installed commercially available systems to provide a snapshot of the extent to which these systems met the needs of the institutions.

Those who are looking for information about the "best" commercially available library management system will be disappointed. This report is not meant to be a comparative study of integrated library systems, nor does it analyze all of the features of these systems. The focus of this study is the needs of libraries, and the analysis is meant to help librarians determine to what extent the integrated library systems vendors deliver products to meet those needs. Any librarian in the process of choosing an integrated library system will have to do far more research than is detailed in this report, but we hope that the discussions of company philosophies and approaches will stimulate library discussions about long-term institutional strategies.

Leigh Watson Healy has provided an excellent starting point for discussions that must take place in all sizes and types of libraries as they begin to make use of Web-based technologies for the discovery and retrieval of information in many different formats. We are pleased to offer this report as a stimulus.

Deanna B. Marcum
President

The Approach

The author interviewed library directors and managers to gather information about their visions, plans, and needs for enabling technology in their libraries. During September and October 1997, the author talked with more than 30 contacts from 17 college, research, and public libraries, including one public library network. The purpose of the interviews was to gather perspectives on the role of the library system in today's libraries. The interviews focused on what libraries need from library system vendors. The information provided helped to frame issues and questions for further exploration with library system vendors. In addition, the brief case studies that follow provide a snapshot of how library systems are implemented in libraries today. Drafts of the case studies were shared in each instance with the individual library for review and comment.

The next project phase, between October 1997 and January 1998, consisted of in-depth interviews with the president or other senior executives of selected vendors. The author chose 12 vendors of library management systems for interviews and further study. The author was selective rather than comprehensive in the choice of vendors, as an exhaustive review of available library systems was beyond the scope of the study. A number of new library system options have become available recently. We therefore focused on vendors that have introduced new or next generation library systems that are client/server based and actively marketed in North America.

The author supplemented the interviews with information supplied by the vendors, Web information, and information provided by fax, phone, and e-mail in response to follow-up questions. From the information gathered about the vendors' strategies, goals, and plans, the author developed vendor profiles, which explore the strategic direction and goals of each company and primary characteristics of each system. Through the vendor profiles and this analysis, the author raises questions for further examination and provides a basis for differentiating between vendors at the "big picture" level.

The inclusion of any product or business in this study is not an endorsement. This report was written by a librarian for other librarians, in good faith, and the opinions expressed are those of the author. In each case a draft narrative was shared with the vendor for review and error correction. The author and the Council regret if factual errors remain, in spite of the vendors' reviews of the draft narratives. Readers may obtain detailed information directly from the individual companies or their Web sites.

Acknowledgments

The author wishes to thank the Council on Library and Information Resources for the opportunity to carry out this study, and Deanna Marcum for her guidance throughout the project. The project advisors—Malcolm Getz, Roy Heinz, Michael Keller, Marilyn Gell Mason, and Dan Tonkery—deserve special appreciation for their consultation, advice, and comments throughout the planning, research, and analysis phases of the project.

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The author acknowledges that product names mentioned in this report may be the intellectual property of their respective companies.

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Introduction

BACKGROUND

As libraries develop digital library projects, they are choosing and implementing an array of technologies to achieve seamless access and delivery of traditional and electronic information resources. This study looks at institutions that are building digital libraries. It explores how library management systems (LMS) fit into this new framework.

During the last two years, competition in the library systems marketplace has increased. Traditional vendors have launched new or next-generation library systems and new players have entered the North American library market. Today, more than a dozen vendors offer library management systems based on client/server architecture, with the benefits of scalability and open design. Many of these new library systems use current programming languages and technologies like Java, ActiveX, and CORBA. These systems have achieved varying levels of maturity, robustness, essential functionality, and support for core and emerging standards important to libraries.

This report is an overview of the state of the art for those who are concerned with the development of digital libraries and the role of library management systems in libraries today. The audience for this report will likely include

- library administrators who are choosing and incorporating new library management systems into the institution's technology infrastructure,
- library managers who are involved in selecting systems, and
- systems librarians who support library technology daily.

This review will be useful to those managing companies that develop and supply technology and systems to libraries. It offers insight into issues that concern librarians as they integrate digital libraries and traditional library services. We have tried to identify key issues and to point readers to sources for further exploration.

Surveys elsewhere in the literature examine and compare system features. This report contrasts librarians' visions and strategies with the development philosophies of the systems vendors that serve them. By summarizing the state of the art from a strategic perspective and raising questions for further examination, we are providing additional context for librarians to evaluate their choices.

This study will use the term "library management system" or "library system" to refer to systems that libraries employ to support staff work processes and to provide online catalogs for patrons and staff. Although the terms "library automation" and "integrated library system" are still in current use, these terms seem archaic in today's world. As they undertake the creation of digital libraries and redesign workflows for greater effectiveness, libraries have largely moved beyond the idea of mere automation. For many libraries, the "integrated" library system is one of various technology components incorporated into the institution's information-access infrastructure.

Library Perspectives

USER COMMUNITIES

The libraries included in this study were academic institutions serving user communities that range from 3,000 to 50,000 faculty, students, and staff; a government research lab with 4,500 employees; and public library institutions that support populations in the millions. These libraries and others are engaged in using communications and information technology (IT) to transform the way they support their institutions' missions in research and education.

We asked these libraries to talk about the changes they expect in their user populations and the implications of those changes for future services. A number of libraries reported that remote users will become a larger percentage of the population served. Some campuses anticipate that distance education students will account for most future enrollment increases. Some academic institutions are extending library services to a wider community beyond the campus boundaries. The public library institutions reported feeling the strong impact of changing demographics, especially as new immigrants arrive in the community with new languages and cultures.

Patterns of library usage vary widely across the institutions interviewed. Academic libraries, however, generally reported that students use the library more often onsite. Faculty visit the physical library less often and are the heaviest users of interlibrary loan services. Some libraries continue to experience intense onsite usage. Others see users coming to the physical library less and report much more virtual traffic.

The libraries highlighted in this report understand the needs of their user communities. They are planning and implementing services based on that knowledge. Some libraries have informal processes for assessing the needs of their users; some expressed a need for better user studies, saying that they relied on generalizations from daily experience with users. Others use formal processes for surveying users and identifying their information-seeking behaviors and needs. One research library actively works with users in a prototyping lab to design and test user interfaces.

VISIONS AND STRATEGIES

The Web has reached critical mass as a consumer marketplace and information delivery medium. Library users' expectations of information services are increasing. For students and researchers, scholarly and reference information is becoming widely available online through libraries and directly on the Web. All the libraries interviewed and profiled here are rapidly building the technology and content foundation to make these electronic resources widely available to their users.

The librarians we talked to articulated these goals most often:

- to build the infrastructure to make the greatest number of resources, regardless of format, widely accessible on the user's desktop, and
- to enable library users to become more self-sufficient.

These libraries expect to offer print and digital resources "side by side" for many years to come. They are searching for the best means of making this information available to the public. Most often, the libraries' Web pages are now the front door to a multitude of networked resources and information gateways. These libraries have made the Web their technology platform. Web browsers are becoming the common user interface through which users locate content and bring it to their desktops.

A number of libraries are addressing the reliability of Web resources for research purposes, in addition to Web access to databases, news resources, electronic journals, and digital library collections, among many other resources. These libraries are selecting, organizing, classifying, and making accessible authoritative Web sites via the libraries' Web pages. This gives researchers ready access to dependable resources. [1]

Most of these libraries are increasing the number of tools available for patron independence. User self-sufficiency was sometimes cited as an explicit goal in libraries' strategic plans. By providing more unmediated services, libraries hope to free staff to focus on services that require human interaction (such as finding, evaluating, and synthesizing information for patrons). A number of libraries reported that increased self-sufficiency also increases patron satisfaction.

To make information access as friendly and easy as possible, some libraries are addressing the ergonomics of access and retrieval. They are also providing users tools to manage and manipulate information at the desktop. Several libraries are creating desktop access to "virtual information space." In this environment libraries are giving users tools for analyzing, word processing, charting, putting data into spreadsheets, and presenting data once it has been retrieved. One librarian said the goal is to develop a digital library service that is "user-based...highly distributed...point of use...outreach-oriented ....We want to act less as present intermediators, more as teachers, facilitators, designers, builders."

ROLE OF THE LIBRARY MANAGEMENT SYSTEM

From the interviews, we concluded that libraries are still choosing library management systems (LMS) as the primary means for acquiring, organizing, managing, and presenting locally held collections. Libraries are increasingly choosing systems with multimedia aspects to support their diversifying collections. Libraries also want systems that will support improved efficiency through streamlining staff work and helping reduce labor-intensive tasks.

But there has been a sea change in thinking about the role of the library management system in today's library. With the Web flourishing, and creating both chaos and new opportunities, libraries are moving with a sense of urgency to adopt technologies that will allow them to capitalize on the opportunities they see. For many libraries, the concept of integration has taken on a new meaning. Many library leaders now view the network as the center of the library's technology infrastructure. Unwilling to wait for one holistic library technology solution, if such will ever exist, libraries are choosing components from a range of technology options. They are integrating these components into an overall technology framework. The library management system is but one component that links to other systems, databases, and technologies, with the Web as the common denominator.

Increasingly, libraries are taking responsibility for the public access component of their "integrated system." Some librarians consider the quest for a single consistent user interface no longer an issue. They report that browsers like Internet Explorer and Netscape have solved the issue, at least for public access. Others are seeking better integration of the library's disparate electronic resources. They hope that the use of a single Z39.50 client, such as OCLC's WebZ, will provide the integration. The libraries we interviewed generally see the library's Web pages, not the OPAC, as the entry point for library users. Through the web pages the user gains access to the library catalog, networked information resources, and locally created information.

Asked to articulate the role of the library management system in the current library technology environment, library leaders indicated that a clearly defined role for LMS is difficult in this time of transition. Some librarians see a growing separation between public access and the traditional processing aspects of the library systems. Some librarians doubted whether library systems vendors will be able to meet all the needs of digital libraries. They still see library systems supporting the acquisition, organization, and presentation of roles for locally held resources.

The following comments show how the librarians we interviewed see the library system's role in libraries today and in the future.

> "I don't know what [the LMS] should be. We want it to be able to do the kinds of processing we need. We want it to be able to deal with reserves. We want it to be able to deal with interlibrary loan. But in actually delivering all of the information that we want to put out there for our user community, I'm not sure that what we used to think of as the integrated library system can do all that. I think we are at a crossroads, and it's very difficult to chart the course right now."

> "I just don't believe that there is an integrated library system, if you're talking about a system that's available for sale. At a library like this one, I think we're going to be putting together component parts to do what we need to do here, and we'll be taking advantage of a lot of opportunities that we see out there."

> "The Web is changing the way people look at things. With a whole generation that's grown up in a different way, what will push them [to the traditional catalog], or do we have to be thinking of the Web page as our systems? I think we have a new hammer and shouldn't be seeing everything as the old nail."

> "For me, the old integrated library system is really boring. We have to spend so much time and energy implementing this classic integrated system, but there are functions and operations that you have to do. The more exciting things of course are the gateway work, trying to create some kind of gateway or interface to the vast world of information. And to help people get to it."

> "In fact, the integrated system is probably not going to be as important as it has been in the past. There will be a close merging of [electronic resources and the traditional catalog] but, it's hard to say whether it will all be managed by the integrated system."

> "Work flow management...is the future of library systems."

"Those vendors and their products were posited on a model of a library where a local collection was essential and the ability to provide service was 80% fulfilled from that collection. You have then a marginal 20% that you did through other systems like interlibrary loan. We've already redefined that model over the past five years to say that it's documents from any source, including your own local collection. It's a workflow centered model. You have to develop workflows to define which paths for information service delivery you're going to use...totally outside the realm of what an integrated library system does. The fact is the market has changed entirely. It's as if you're asking how the glass manufacturing industry is supporting the dairy industry these days. It's not, because the dairy industry is not using glass anymore."

"The problem is we're in such an early stage of defining the architecture of the digital library system that no one is doing a good job yet of defining what the functions of systems should be. It's hard to say what a good, responsive system is....Vendors have very little vision of where they fit...not close to the issues at all....The task [for us] was to educate vendors that they would only be a part of a digital library system."

Some librarians expressed hope that libraries and vendors can work cooperatively toward a shared vision:

"The job of the library is to organize [this wild proliferation of databases and tools]. Optimally, the front end of the catalog would be the front end to this world. To do this, it has to be a toolkit, not a [prebuilt] solution."

"My vision is one in which a vendor is truly interested in working with the client to make the system work better."

"[We need] partnerships in a new sense, not merely getting us to buy their products, but working together in shaping the future, finding where there are ingenious things they can do to develop or improve their product line to fit within this new complex structure and increase their reliability....They can play more and they'll benefit from it enormously."

"A library system should be highly standards-based, open with regard to hardware and telecommunications architectures. Streamlined processes, excellent documentation, and customer-responsive training and support are essential. In addition, a library system should be innovative, looking to its users as full partners in the development of new services, rather than development by the vendor without user cooperation. Finally, a library system should integrate seamlessly with online services developed in-house by the library so that the user has transparent access to all services the library offers."

TRENDS AND ISSUES

The libraries in this study envision the coexistence of print and digital resources into the indefinite future. As they are simultaneously developing solutions for legacy print collections and for digital libraries, librarians spoke of many issues that must be addressed. Some important issues have been discussed for at least a decade and remain concerns of librarians today. Workable solutions are yet to be identified either by institutions or vendors. [2]

Managing Costs

Under sustained funding constraints for the last decade, library operating budgets have been unable to keep pace with the cost of building library collections. While they struggle to maintain their print collections, libraries are also advancing rapidly to acquire electronic resources and to build the technology infrastructure to create seamless information environments. The costs of satisfying library patrons' appetites for online information resources are increasing faster than libraries can offset the costs by canceling print publications.

Another level of costs confronts libraries as they network information and create their digital libraries. In the interviews, libraries repeatedly expressed concern about the costs of operating in a client/server technology environment. In many institutions, the cost burden has shifted as institutions decommission centralized mainframe computers and libraries assume the costs of developing and maintaining PC workstations and distributed networks. According to industry experts, costs for libraries of supporting and upgrading networks and peripheral equipment are increasing faster than costs are dropping for central site hardware and applications software that are used to support library systems. Several library systems vendors reported that their product strategies are intended to help libraries better manage and plan their hardware and network investments.

Based on these new economic realities, libraries are reallocating resources and pursuing alternative strategies to stretch resources further. In recent years, libraries have experimented with a variety of solutions to extend their purchasing power. These solutions include journal cancellation projects, improved document delivery and resource sharing models, and consortial site licensing for electronic resources.

Libraries are also responding to economic pressure through continuous re-examination of library processes. The goal is to carry out work more efficiently, freeing resources for reallocation to areas needing investment. Libraries interviewed for this study often mentioned the need for better tools for doing library work. They want flexible library systems that can conform to new work processing models as they evolve. They want to interface with a variety of systems and vendors that can help streamline work through electronic transmission of acquisitions information. One case study that follows looks at a library workflow redesign initiative and the support needed from the library's acquisitions and systems vendors.

Technology Infrastructure and Library Staffing

Libraries reported that development of their digital library capabilities is producing many changes in the library. Flatter organization charts and more reliance on teams result, as libraries strive to reallocate resources to patron-focused activities. Some libraries are increasing the library's information systems (IS) staff. Digital library developments are also putting librarians in much closer working

relationships with the IS staff in their institutions. Together they are developing institution-wide solutions.

Libraries often spoke of the need to have the technology and infrastructure in place to make the library as flexible as possible. With changing access patterns, libraries are now used around the clock, from anywhere patrons are. Libraries see an increasing need for IS and vendor support for systems and networks.

Access and Interoperability

The library systems integration challenge is considerable, as libraries connect disparate systems handling disparate kinds of materials. As one library director stated, "the world and the set of tools that we're just beginning to use is much more complicated than anybody imagined it would be in terms of how things potentially interconnect....Working the way between the hypothesis and the delivery is very complex."

Security, Authentication, and Authorization

A key issue for the libraries interviewed was how to protect electronic data while at the same time providing as much access as possible. Authentication and authorization of users, along with attendant licensing and copyright issues, was repeatedly mentioned as a concern. Also often mentioned was the issue of archiving and preserving the recorded knowledge represented in electronic information.

CONCLUSIONS

In talking to the librarians in this study, we concluded that many embrace the systems integration role in supporting their strategic visions for public access services. They are moving rapidly to blend content, access tools, and supporting technologies to create digital libraries. They are seeking to provide integrated access to these tools and resources from the user's desktop. Librarians expect to continue selective implementation of the best technology options available to them. Library/vendor relationships increasingly will be based on flexibility, openness, innovation, and the synergies that can be achieved by partnering to meet the institution's strategic objectives.

Analysis of the Vendor Profiles

MARKETS SERVED

Collectively, the 12 vendors profiled serve libraries of all types and sizes, including K-12 schools, special and government libraries, public libraries, college and university libraries, academic research libraries, national libraries, and consortia. Their installed base of systems at libraries is predominantly in the United States.

All the vendors are looking for ways to retain and increase their market share. With the introduction of flexible and scalable client/server systems, vendors see opportunities to expand their markets. Some vendors that have traditionally served large libraries are now trying to attract more medium-sized libraries. Several companies with new systems aspire to join the ranks of vendors that serve large libraries. Vendors that have served mainly public or special libraries now expect to win more academic libraries or plan to move into the school market. Other vendors are focused on retaining their customer base as they introduce next generation systems. A couple of companies are concentrating on securing business with libraries that are replacing older, outmoded systems. Several companies are seeking international growth, while one company with an international customer base has gained a foothold in the United States as a new market.

With the delivery of these new library systems, the already competitive library systems industry has become even more so. Several vendors deem the industry ripe for consolidation and predict that the end of 1998 will see fewer companies in the market.

Not all vendors released financial information, but, from the available data, it can be seen that some companies are growing fast, while others are experiencing flat or negative growth. Libraries choosing systems should ask potential vendors for financial information and examine the reasons for a company's performance. Flat or declining revenues from one year to the next may indicate different things: that a company has a systemic problem, that customers are defecting, or perhaps that a vendor's customers waited to make commitments for systems that had not yet been delivered. On the other hand, fast revenue growth may not necessarily correlate to customer satisfaction. Potential customers of a fast-growing company should look at the company's track record for supporting its customers while in a growth mode, to ensure that customer service is keeping pace with the company's marketing efforts. Beyond revenues and profitability, libraries should also examine whether a vendor has the means to invest in future technologies and the ongoing development of its product line.

VISIONS

To help in understanding the direction that library systems companies are pursuing and the philosophies guiding their product development, the author asked each company to talk about its vision and goals. In the interviews, vendors voiced corporate goals that varied with each company and that typically focused on expectations for company performance or market position. Goals expressed for the coming year include:

- to innovate, provide outstanding technology,
- to grow and expand the market,
- to provide excellent customer service,
- to provide a good work environment,
- to run a well-managed company, and
- to achieve quality.

More detail is available in the individual vendor profiles following, in which vendors' goals and strategies are explored more extensively.

When asked to articulate their visions for the library system and its role in the library, the visions of company leaders converged on the library as the "information hub" of its campus or community. In this vision, the library system plays a strategic role as the central technology of the library. The library system is seen as the gateway to information and, through one common interface, the finding tool for all types of information to be found locally or on the Internet. Most vendors asserted that the OPAC should be the logical entry point for a library's patrons to access all information resources.

As they develop systems using open design architectures, several vendors envisioned improved interoperability between LMS and other databases and systems that serve libraries. Most vendors do not envision true "plug-and-play" modularity, preferring to develop and deliver whole integrated systems. A few vendors expressed the hope that library systems eventually will be open enough that libraries may select and implement modules from different vendors' offerings, utilizing open Application Program Interfaces, EDI, and Z39.50 standards for interfacing. In this vision, the serials module from one system, for example, would operate with the OPAC from another. Some companies expressed dissatisfaction with the current level of Z39.50 compliance and usability across disparate systems and databases, calling for more cooperation from libraries and the industry in implementing the standard.

PRODUCT DEVELOPMENT

Product Planning

Good market information is essential to developing effective product strategies and ensuring that library systems meet customer needs. The author explored with all the companies how they gather input to define their products and their development priorities. The companies all reported being driven to some extent by marketplace and technology trends. Several described the need to strike a balance between responding to customer requests for product enhancements and building what the vendor thinks libraries need. All reported having a formal process for setting product development priorities. Most are based on gathering input from user group meetings, enhancement lists, and listservs; focus groups; and internal market analysis and product planning processes.

The companies indicated that input is also gathered informally from sales processes, customer feedback, RFPs, consultants, and visits to customers. Several companies mentioned that feedback and requests from current customers tend to result in incremental product changes or "tweaking" the current product at a feature level. These companies make a point of trying to uncover needs that customers themselves may not recognize, since customers' input may be limited by their experience. Some companies host meetings of library directors, who provide input at a strategic level.

The nature of customer/vendor relationships varies. Some companies seem to have a more technology-centered approach to developing product strategies, preferring to keep customers at a safe distance, while others somewhat paternalistically described their role in educating their customers about technology. Some vendors seem much closer to their customers, engaging them in open-ended, ongoing conversations. These companies seem to seek out the pioneers in their customer base who will help push the product to the next level of performance and functionality through strategic development partnerships.

Through the formal and informal processes mentioned for gathering customer input, the voice of the library seems to be well represented for vendors' product planning and design. On the other hand, vendors' access to information about the needs of library users is very limited. It has been the practice in the library systems industry to assume that librarians represent the needs of their users; the vendor rarely consults the end user directly. None of the vendors have processes for involving the patrons of customer libraries in product definition. Nor do they query patrons about their needs and wants. The vendors have no way to assess the potential success of their library systems in meeting end users' needs, except indirectly through feedback from their customer libraries.

With today's emphasis in library systems on the use of Web browsers, "patron empowerment" features, and patron access to networked information, the user controls navigation in this unmediated environment. The user also controls the potential success of new public access products. Library systems designers should be determined to know what library users want and expect from their products.

Execution

Vendors frequently mentioned the fast pace of change in technology and the need to develop and deliver products quickly in today's environment. Many of the vendors are using object-oriented programming, which makes software programs more modular and easier to modify. Several companies mentioned they use Rapid Application Development (RAD) tools to generate programming code quickly. With the use of such tools, some companies reported that they are now able to spend much more time upfront in the design phase of product development. Once the design is set, these tools support rapid advancement through early prototypes that can be tested with customers before the company has to lock in a final specification. These companies reported that they are achieving shorter cycle times from initial specification to final testing and delivery. Their flexible and customer-centered development brings customer feedback into the entire process.

COMPARING CAPABILITIES

At first glance, it may be hard to distinguish between vendors' latest product offerings. In their marketing literature and Web sites, the vendors list technology features—client/server, Java, open systems, thin client, and object-oriented design—to promote their new systems. (See Table 1, page 17: Which System is Which?) Potential purchasers of library systems must move beyond the technology buzzwords to discover the sometimes subtle differences and advantages of one company's approach over another's. Most of the library systems have Web and graphical interfaces to the library catalog and

staff modules, and most have the core functional modules expected in library systems today, that is, serials, acquisitions, cataloging, circulation, and the library catalog.

Rather than exploring the features of functional modules and interfaces in depth, we focused our examination on areas of strategic importance to libraries as they are integrating physical and digital libraries. In the profiles, we attempt to provide information that will aid in comparing and evaluating library systems from this perspective. In this analysis we suggest considerations for further exploration. Table 2 on Pages 18 and 19 summarizes the state of the art of vendors' computing environments; the availability of core modules, user interface, and retrieval capabilities; and support for standards.

Architecture

All of the 12 profiled vendors utilize client/server network architecture for the design of their new systems. For the most part, the companies have adopted open architectures that make use of standard, off-the-shelf software and hardware components. They can be readily interfaced to systems from other companies. In contrast, a closed system based on proprietary design is more difficult to connect to other systems.

The benefits of client/server architecture include increased openness and modularity. This supports making software changes easily. Client/server systems are scalable, so that very large to very small library system implementations can be configured using the same software and by adding more server power. Beyond its essential benefits, the vendors utilize client/server architecture designs that have important differences. [3] Below are brief definitions of the client/server designs employed:

- Two-Tier: the user interface runs on the client. The database is stored on the server. The actual application logic can run on either the client or the server.
- Three-Tier: introduces a middle tier for the application logic. This makes it easier to replace or modify one tier without affecting the others. It distributes processing or applications across a network.
- Multi-Tier or N-Tier: in which application and database layers can be scaled independently for distribution across a network.
- Thin Client: client software designed to require low system resources, relying on the server for the bulk of the data processing. This controversial approach may offer institutions benefits of reducing costs of owning and supporting PC hardware; successful implementation assumes an institution's network is robust and reliable, with ample bandwidth.

In considering library systems using client/server design, libraries should consider each system's overall flexibility, scalability, and modularity. One consideration should be the range of library sizes currently supported by a vendor's system installations. How many users, workstations, and records can it support? Client/server systems are inherently scalable. However, in planning a new implementation and for adding future capacity, libraries should be concerned with how scaling works for a vendor's particular system. Another consideration may be whether a vendor has tested and benchmarked its system for databases larger than those currently in production.

Database Management System

Before the introduction of current database technologies, library systems vendors often designed custom database solutions. They were developed specifically for the complexity of library catalogs with their bibliographic data and indexing requirements. As libraries increasingly integrate information

about digital resources with bibliographic data in library catalogs, support from database management systems and data structures requires greater scrutiny. [4]

In today's library systems, relational database management systems (RDBMS) are by far the favored database implementation. RDBMS from companies such as Oracle, Ingres, and Microsoft are widely accepted. The power of relational databases is in their storage of data in related tables. This allows the same database to be queried in many different ways. Structured Query Language (SQL) is the de facto standard for querying and accessing relational databases. Another benefit of relational systems is that a single database can be distributed across multiple servers. This supports scalability. The ability to distribute a relational database also supports virtual catalog implementations. One inherent disadvantage of RDBMS is that there are some restrictions on field lengths and indexing capabilities. This can pose problems for bibliographic databases.

One vendor has announced that it is employing an object-oriented database management system (OODBMS) in its new library system. Although the benefits of OODBMS are not yet proven in library applications, the proponents of object-oriented databases assert that they are well suited to the implementation of complex data models like combined multimedia and bibliographic databases.

Search Engine

Most of the vendors profiled have developed the search engine in their new library system products. Boolean search algorithms and keyword searching are standard capabilities offered. A few vendors have licensed a third-party product as their primary search engine. Some license technology to extend their own engine with more sophisticated and powerful retrieval capabilities. Relevance ranking, natural language searching, word pattern-matching, and online thesauri are among the advanced features these vendors have included in their systems.

Library users increasingly will need more sophisticated tools for successful search and retrieval of information

- as more library catalogs and databases become Z39.50 compliant,
- as libraries catalog Web sites and provide access to digital library collections, and
- as libraries organize and provide access to document repositories.

Satisfying library users' needs for finding the right information in very large databases may be a consideration in evaluating the access component of library systems.

Adaptability

Some libraries have the technical resources and expertise to shape a library system through custom programming, but most libraries need library systems that can be readily implemented "out of the box." In profiling the vendors, the author explored each system's overall adaptability to libraries' local needs and special requirements. Attention to system set-up options and data interfaces between the library system and other systems was a priority.

The majority of the systems examined are adapted to libraries' specific needs through set-up utility programs and adjustments to parameter tables. Standard report-writer packages generate reports, supplemented by library-defined SQL queries. Generally, the vendors aim to provide systems that are readily adaptable without the need for customized programming support from the vendor. In most

cases, vendors also provide Application Program Interfaces (APIs). APIs are protocols for developing interfaces with other systems and for building local routines without the need for root access to the system. Most of the vendors do not provide source code to customers.

An area of ongoing development for many of the vendors is in electronic data interchange (EDI). Transferring data and transactions between library systems and the book and serials vendors that serve libraries is the goal of this development. While ANSI ASC X12 is currently the predominant standard in the United States, EDIFACT is gaining momentum as the universal international standard. The two standards are converging into one global definition for EDI. Of the vendors profiled, some are actively supporting and implementing X12. A few have implemented EDIFACT. Most of the companies have yet to develop and test EDIFACT capabilities. For libraries concerned with reducing work by having vendors electronically transmit acquisitions information, EDIFACT development and the ease of implementation will be important considerations in evaluating library systems.

Supporting Networked Information Resources

As discussed earlier, if there is a shared vision among the vendors profiled, it is one of the library as the information hub of its institution. The library system is the core technology for supporting access to networked information. To varying degrees, all the systems examined were designed to support this vision.

For example, most of the systems accommodate linkage between bibliographic records and Internet resources by embedded URLs in the MARC 856 field. In most cases, users accessing the catalog through a Web browser may click on the URL. This calls up the Internet resource and launches an application program to view an image or video clip, or to play an audio resource. In addition, several companies offer digital imaging systems designed to support the capture, organization, and storage of digital images. Access is integrated through the library OPAC.

Most of the systems support Z39.50 gateway searching of other library catalogs and databases that are Z39.50 compliant. Client and server support for Z39.50 varies by vendor. At the time of this report, not all of the vendors had achieved conformance with baseline requirements of the current version of the Z39.50 standard (version 3, 1995). This version is much richer in functionality than the previous version (version 2, 1992) in supporting access across systems. [5] Z39.50 support will be an important consideration for libraries concerned with interoperability and with OPAC integration of Web-delivered resources.

As libraries network, link to, and create an increasing variety of electronic information resources, it is possible to envision many scenarios involving payments by institutions, and by individuals within institutions, for fee-based information services. Despite vendors' visions of the library system as the gateway to information, strategies for electronic payments are only narrowly supported in the current systems. One vendor has a long-standing history of actively supporting such mechanisms as credit card payment for document delivery by individuals. Another company supports copyright management and central billing for individuals' access and use of digital images. All the other companies reported that they are evaluating or planning support for electronic payments, while two companies reported that they anticipate no plans in this area. Systems or interfaces to systems to support authentication, rights management, and payments mechanisms are becoming mission critical for many libraries.

TRENDS AND ISSUES

Libraries

Among the vendors there was great diversity of opinion about what the future will bring for libraries and their vendors. Some common threads emerged. The vendors generally expect the library to become less a repository of physical materials in the future, and more a virtual gateway to electronic information. Some vendors asserted that libraries will need help from vendors in building the technology infrastructure to support the new paradigm. Vendors also felt that libraries need to do more technology planning and more technology training for staff.

Library Systems Industry

Several company leaders expressed opinions that library systems have become commoditized, with less and less differentiation in terms of traditional library systems functionality. Several vendors felt that basic LMS functions have become fairly consistent across systems and that vendors are more interested in developing interfaces and access tools to support digital libraries. Some vendors asserted that architecture and use of new technologies provide differentiation. Most of the companies, however, are developing on similar design platforms. The library systems industry is ready for consolidation, according to some company leaders.

Several companies reported that the established practice of selecting library systems through complex procurement processes is quite costly for vendors, ultimately adding to the cost of library systems themselves. Some companies expressed concerns that the procurement process works against the concept of developing a strategic vendor/client relationship, by focusing on "checklists and checkboxes" of features and functions. The selection process may be changing as more libraries seem to be moving away from formal RFPs to RFIs (Request for Information), which is a more conceptual, open-ended means of assessing vendor capabilities and fit with a library's needs.

Future of Library Management Systems

The following points summarize different opinions expressed about the direction of library system developments.

- *There will be more separation of public access catalog and staff functions.* Several vendors noted that libraries seem more interested in the public access aspects of library systems than in the traditional LMS functions. Vendors themselves seem to be focusing more on supporting electronic resources and less on library resources that require physical processing.

- *More creative uses of the library system could make it more useful as a management tool.* At least one vendor asserted that, while traditional LMS functions may be viewed as less interesting —"ground already covered"—than public access functions, there may still be opportunities for libraries to use LMS more creatively for streamlining work, for sharing data between library departments, and as a management tool.

- *Object technology will be used to store mixed media in a single database; object technology and Java will support more customization down to the desktop.* While most vendors have focused on Z39.50 to support information sharing, several vendors are exploring the use of CORBA for supporting the

distribution of digital objects. Some vendors are experimenting with the use of Java technology, which they hope will support running robust applications with the use of thin client workstations.

- *Libraries will demand:*
  - *greater multilingual support,*
  - *support for more unmediated services for patrons, and*
  - *greater interoperability.*

  Vendor support for Unicode will become more critical for libraries that want multilingual support in their databases and interfaces. Support for unmediated services is a growing theme as libraries attempt both to reduce costs through streamlined work processes and to allow patrons to access and perform more LMS functions that have been traditionally the domain of library staff, such as reserving, checking out, and renewing materials; and placing interlibrary loan and document requests.

- *Libraries are "all" automated now; the next major step is resource sharing, making support for ILL protocols critical.* An area in which vendors can support libraries both in automating work processes and in improving access to information is in interlibrary loan. A number of vendors see interlibrary loan and resource sharing as a key area for developing library systems and for interfaces between systems. Several vendors are active members of the NAILLD Interlibrary Loan Protocol Implementors Group (IPIG), which represents a commitment to test and implement the emerging ISO standards for interlibrary loan transactions. [6]

CONCLUSIONS

The primary emphasis of recent library systems development has been on deployment of traditional LMS functionality on new open systems architectures. The move to open systems supports easier interfacing between disparate systems that are being integrated within libraries' institutions. The newer library systems architectures have much greater appeal to those concerned with technology infrastructure purchases. This technology-centric focus has also effectively leveled the playing field in the library systems market, as open systems are more easily commoditized. Competition among library systems vendors has greatly increased.

We concluded from talking to libraries that success for library systems companies into the future may depend upon these companies becoming service businesses, rather than product-focused companies. In the relatively small library market—in the context of IT markets in general—companies may find that their growth prospects lie in differentiating their products for specific library market niches, cultivating closer market relationships in those niches, and focusing squarely on understanding and meeting the needs of library end users.

Table 1: Which System is Which?

Fully integrated...the best solutions that can be delivered...Windows NT...an array of extraordinary technical features...the system that redefines integration...totally scalable
—*The Library Corporation's Library•Solution*

Premier client/server information management system...our systems set the pace for information access and delivery...powerful and flexible integrated solution using client/server technology and open systems
—*Ameritech Library Services' Horizon*

Cooperative partnership with a core group of librarians...Windows NT-based, distributed client/server product...seamless suite of library functions...conforms to the library's own, traditional workflow...flexible interface capabilities...focus on access to electronic resources
—*Gaylord Information Systems' Polaris*

A highly-configurable, integrated library system...blend of power and versatility...technological breakthroughs...client/server architecture for growth...a unique concept in on-line integrated library systems...all modules function seamlessly on a common bibliographic database ...easy-to-use operator interface
—*SIRSI's Unicorn*

A truly integrated system...supremely adaptable...effectively integrating multiple information functions and sources...open system structure ...client-server...commitment to ISO standards
—*Ex Libris's ALEPH500*

An evolving, technologically current, functionally rich library system...Java-based interfaces and applications...thin-client technology...a common GUI client interface across all system modules ...for maximum ease of use
—*Innovative Interfaces' Millennium*

A state-of-the-art, open system with architecture designed explicitly to manage high volume transaction processing, facilitate computer-to-computer communication, and expedite network transaction activity...client/server technology ...history of partnership with creative library leaders
—*CARL Corporation's CARL System*

A third-generation, Windows-based, integrated library automation system...advanced features ...data management, software development, and network delivery...workflow management for library staff...powerful, flexible and convenient access to distributed multimedia information
—*VTLS' Virtua*

Object-oriented...standards-based system...ability to incorporate libraries' "real world" workflows...flexibility to meet individual requirements...latest technological design tools available—*DRA's Taos*

Powerful, GUI-based integrated library information management system...scalable, open systems design...powerful management tool...one-stop gateway to the world of information
—*EOS International's Q Series*

Multi-tiered client/server system...access to network resources from the OPAC seamlessly ...the only complete native Windows system available today...library-defined real-time indexing...integrated document management system—*Endeavor Information Systems' Voyager*

A complete solution for automating and streamlining the daily operations of a corporate, government, legal or special library...relational database is optimized for text, documents, and objects...ready to use, but fully customizable for a Windows or Intranet environment
—*Information Dimensions' BASIS TECHLIB*

Table 2

Vendor*	Ameritech	CARL	DRA	Endeavor	EOS Int'l	Ex Libris
Library System	**Horizon**	**CARL System**	**Taos**	**Voyager**	**Q Series**	**Aleph500**
Architecture	Two-Tier Client/Server	Three-Tier Client/Server	Multi-Tier Client/Server	Multi-Tier Client/Server	Three-Tier Client/Server	Multi-Tier Client/Server
Operating System						
Client	Windows 95 or NT; Web browsers	Windows 95 or NT; Web browsers	Windows NT; Web browsers	Windows 95 or NT	Windows 95 or NT	Windows 3.1, 95, or NT
Server	Windows NT or UNIX	Tandem	Windows NT or UNIX	UNIX	Windows NT or UNIX	UNIX
DBMS	RDBMS: Sybase or Microsoft SQL Server	RDBMS: Tandem Enscribe	OODBMS: ObjectStore	RDBMS: Oracle	RDBMS: Oracle or Microsoft SQL Server	RDBMS: Oracle
Search Engine	Ameritech proprietary	CARL proprietary	DRA proprietary	Endeavor proprietary	Excalibur RetrievalWare	Ex Libris proprietary
Availability						
Acquisitions	Now	Now/*GUI: March 1998*	Q3 1998	Now	September 1998	Now (GUI in beta)
Cataloging	Now	Now	Q3 1998	Now	Now	Now
Circulation	Now	Now/*GUI: March 1998*	Q3 1998	Now	Now	Now
Reserves	Now	Now	—	Now	1999	—
ILL	Now	1998	Q4 1998	1998	1999	Now
Media Booking	Future	—	1999	Q1 1998	1999	—
Serials	Now	Now/*GUI: March 1998*	1998	Now	July 1998	Now (GUI in beta)
OPAC	Now	Now	Now	Now	Now	Now
Interface to CD-ROM Server	Now	Now	Now	Now	Now	Now
Z39.50 Gateway Search	Now	Now	Now	Now	July 1998	Now
Full-Text Retrieval	Now	Now	Now	Now	Now	—
Full-Text Search	Now	Now	—	—	Now	—
Graphical User Interface	Now	Now	Q3 1998	Now	Now	Now
Multimedia Retrieval						
Images	Now	Now	Now	Now	Now	Now
Audio	Now	Now	Now	Now	July 1998	Now
Video	Now	Now	Now	Now	1999	Now
Bib Import/Export	Now	Now	1998	Now	Now	Now
Authority Import/Export	Now	Now	1998	Now	Now	Now
Standards Supported						
Z39.2 (MARC)	Now	Now	1998	Now	Now	Now
Z39.50	Now	Now	Now	Now	Now	Now
EDIFACT	Future	Now	Future	Now	1998	1998
Unicode	Future	Q2 1998	Now/1998	Q4 1998	1999	1998
Year 2000 Ready	Now	March 1998	Now	Now	Now	Now

* This summary provides a "snapshot" of the current state of library management systems' computing environments and availability of key capabil the individual profiles for more detail and contact the vendors directly for the most up-to-date information.

Vendor	Gaylord	IDI	Innovative	SIRSI	TLC	VTLS
Library System	**Polaris**	**BASIS TECHLIB**	**INNOPAC/ *Millenium***	**Unicorn**	**Library• Solution**	**Virtua**
Architecture	Three-Tier Client/Server	Three-Tier Client/Server	Thin Client	Three-Tier Client/Server	Multi-Tier Client/Server	Three-Tier Client/Server
Operating System						
Client	Windows 95 or NT; Web browsers	Web browsers	Web browsers	Windows, Macintosh, or UNIX	Windows NT; Web browsers	Windows 95 or NT (also 3.1, 3.11 on OPAC)
Server	Windows NT Server	Windows NT Server; Internet Information Server	UNIX	UNIX	Windows NT; Microsoft SQL Server	UNIX
DBMS	RDBMS: Microsoft SQL Server	RDBMS: BASIS	DBMS: Innovative Interfaces proprietary	RDBMS: Informix	RDBMS: Oracle	RDBMS: Oracle
Search Engine	Gaylord proprietary	BASIS	Innovative proprietary; Fulcrum	BRS/Search	TLC proprietary	VTLS proprietary
Availability						
Acquisitions	Now	Now	Now/ *1998?*	Now	June 1998	1998
Cataloging	Now	Now	Now	Now	Now	Now
Circulation	Now	Now	Now/ *1998?*	Now	Now	Now
Reserves	Future	—	Now	Now	March 1998	Now
ILL	Future	Now	Now	Future	June 1998	Future
Media Booking	Future	—	Now	Now	Nov. 1998	Future
Serials	Now	Now	Now/ *1998?*	Now	June 1998	1998
OPAC	Now	Now	Now	Now	Now	Now
Interface to CD-ROM Server	Now	Now	Now/Now	Now	Now	Now
Z39.50 Gateway Search	Now	Now	Now/Now	Now	Now	Now
Full-Text Retrieval	Now	Now	Now/Now	Now	Now	Now
Full-Text Search	—	Now	Now/Now	Now	Now	Future
Graphical User Interface	Now	Now	Now/Now	Now	Now	Now
Multimedia Retrieval						
Images	Now	Now	Now/Now	Now	Now	Now
Audio	Now	Now	Now/Now	Now	Now	Now
Video	Now	Now	Now/Now	Now	Now	Now
Bib Import/Export	Now	Now	Now	Now	Now	Now
Authority Import/Export	Now	Now	Now	Now	Now	Now
Standards Supported						
Z39.2 (MARC)	Now	Now	Now/Now	Now	Now	Now
Z39.50	Now	Now	Now/Now	Now	Now	Now
EDIFACT	Future	1998	Future	1998	Future	1998
Unicode	Now	—	—	1999	—	Now
Year 2000 Ready	Now	Now	?	Now	Now	Now

RELATED REFERENCES AND URLs

1. Libraries interested in further information and resources about cataloging electronic resources will find useful two Web sites maintained by International Federation of Library Associations and Institutions (IFLA): "DIGITAL LIBRARIES: Cataloguing and Indexing of Electronic Resources" at http://www.ifla.org/II/catalog.htm and "DIGITAL LIBRARIES: Metadata Resources" at http://www.ifla.org/II/metadata.htm. These and other resources related to all aspects of creating and managing digital libraries are listed in "Digital Libraries: a Selected Resource Guide" by Katharina Klemperer and Stephen Chapman at http://www.lita.org/ital/1603_klemperer.htm.

2. See Clifford A. Lynch, "Evolution in Action: The Demise of the Integrated Library System and the Rise of Networked Information Resources," *Library Software Review* (September-October 1991): 336-337, and Lynch, "Linking Library Automation Systems in the Internet: Functional Requirements, Planning, and Policy Issues," *Library Hi Tech* 7, no. 4 (1989): 7-18.

3. An overview of client/server architecture in library systems is "Java, Network Computers and Network PCs" in *Biblio Tech Review*, October 1997; available from http://wkweb3.cableinet.co.uk/biblio/html/java__ncs_and_netpcs.html.

4. An overview of database management systems utilized by library systems vendors is given in: "Data bases" in *Biblio Tech Review*, August 1997; available from http://wkweb3.cableinet.co.uk/biblio/html/databases.html.

5. Updated information and links related to the Z39.50 standard is located at the Library of Congress Web site, as LC is the official maintenance agency for this standard: http://lcweb.loc.gov/z3950/agency. Two useful overview articles on Z39.50 are: "Z39.50: Part 1-An Overview" in *Biblio Tech Review*, October 1997; available from http:// wkweb3. cableinet. co. uk/biblio/html/z39.50.html and "Z39.50: Part 2-Technical Details" in *Biblio Tech Review*, October 1997; available from http://wkweb3. cableinet.co.uk/biblio/html/z39.50_part_2. html.

6. For background on the Association of Research Libraries' North American Interlibrary Loan and Document Delivery (NAILDD) Project, see the project Web site at http://www.arl.org/access/naildd/naildd.shtml.

CASE STUDIES

Argonne National Laboratory

SUMMARY

At Argonne National Laboratory, the Technical Information Services (TIS) department provides information products and services through traditional and digital libraries. TIS operates ten subject libraries that are open to users around the clock. As a research facility, Argonne's programs depend on reliable access to both internally generated and external sources of scientific and technical information. TIS has been working to provide networked access to a wide variety of information resources through its Web pages. The TECHLIB library management system is the underlying technology for the library catalog and for supporting TIS' traditional library functions. The Web is the integrating technology. TIS expects Web technology to continue having a major impact on future enhancements to information services.

ARGONNE NATIONAL LABORATORY

URL: http://www.library.anl.gov

Established in 1946 as the United States' first national laboratory and currently operated by the University of Chicago, Argonne National Laboratory (ANL) is a Department of Energy research center. Argonne has about 4,500 employees, of which there are roughly 1,775 scientists and engineers. Argonne's researchers conduct work in basic science; scientific facilities, including the design and building of other research facilities; energy; and environmental management. Argonne's publicly funded research projects have been commercialized through at least 30 spin-off companies in the past 15 years.

To support its researchers and nearly 200 projects, Argonne's Information and Publishing Division (IPD) provides technical library, media, computing, and publishing services. As an IPD department, Technical Information Services (TIS) provides information products and services through traditional and digital libraries. TIS assists users with retrieving, analyzing, and communicating information. In addition to its central support operations, TIS operates ten subject libraries at the Argonne site. All ten libraries are open to Argonne researchers 24 hours a day, 7 days a week.

Scientific and technical information and the infrastructure that supports information management are critical to Argonne's mission. Each research program has its own underlying information support, in addition to institutional-level information management. Argonne's programs depend both on reliable access to internally generated information, and on scientific and technical information developed outside the Laboratory.

To support its mission and goals, Argonne is converting all its information systems from a mainframe environment to a distributed client/server environment using UNIX servers. Near-term goals are to make the Laboratory's business systems compatible through use of standards and common practices. Their goal is future interoperability. Web browsers and thin clients are the user interfaces to the client/server-based administrative systems and to TIS information services.

ARGONNE'S TECHNICAL INFORMATION SERVICES

Through its Web pages and onsite terminals in each of the libraries, TIS offers Laboratory staff access to both printed and electronic resources. Resources and access tools include:

- The ANL Libraries Electronic Catalog, ALEC, containing records for more than 550,000 technical reports; 65,000 books; 5,400 journals; as well as maps, standards, patents, cataloged Web sites, and other materials in various media;
- Access to Argonne's customized version of ISI's Current Contents databases;
- Electronic journals—nearly 200 titles;
- TIS' links to authoritative Web sites categorized by subject area; and
- Full-text and HTML versions of ANL laboratory manuals and other Laboratory documents.

ANL researchers and staff and University of Chicago users access TIS information resources using Web browsers. Some resources also support telnet and dial-up access. Authorized users can be authenticated for dial or Web access from off campus, which enables remote access to resources.

THE TECHNOLOGY SOLUTIONS

In order to create an effective information infrastructure and to provide state-of-the-art access tools for ANL researchers, TIS needed to replace an internally developed system. The internal system produced a computer-output microfiche library catalog, with inherent access limitations. TIS implemented a new library management system in the early 1990s. Since that time it has been selecting new content resources and adding value to them through access tools. The TECHLIB library management system from Information Dimensions, Inc. (IDI) is the underlying technology for the ALEC library catalog and for supporting TIS' traditional library functions. [1] Today, Argonne researchers use a BASIS Web gateway and TIS Web pages as the integrating technology platform to access the ALEC/TECHLIB system and document- and Web-based resources. IDI's BASIS is a relational database management system with an enhanced search engine.

Through these initiatives, TIS supports Argonne's information management plans and goals to:

- maintain a state-of-the-art, standards-based communications and computer networking infrastructure supporting internal and external information exchange; and
- maintain strong core competencies in, and apply, emerging information technologies supporting the mission.

IMPLEMENTATION

Because it is an overhead department, TIS' selection and implementation of its original library system and major enhancements was dependent on funding approval each year. Funding for major technology improvements is allocated separately from operating funds at the Laboratory. TIS competes for funds along with other administrative computing projects.

The TECHLIB System

The process of selecting a library system for Argonne began in 1988 when TIS received funding approval to create a technology plan for information services. The next year, TIS received funding for retrospective conversion of the libraries' bibliographic records. During 1989 and 1990, TIS developed its specifications for a library system and visited companies that offered library systems consistent with Argonne's needs. In 1990, TIS received funding for licensing the library system itself. They selected the TECHLIB system through a formal procurement process.

Of the library systems available at the time, TECHLIB met Argonne's requirements and was selected for licensing. In developing the criteria for selecting a library system, TIS was looking for a library system that:

- would operate on the DEC VAX hardware that was already in operation at the Laboratory;
- had all modules (OPAC, serials, acquisitions, etc.) complete and fully integrated so that one system could be implemented for all library functions;
- had a fully integrated relational database management system that would allow TIS to manage the libraries from a database perspective, provide TIS with future capabilities of handling full-text resources, and would not require an additional third-party software license;
- had a non-proprietary hardware and operating system platform so that it would leverage the existing hardware base at the lab; and
- was based on logical workflows, so that no customization of source code would be required to adapt the system to the libraries' needs.

To support migration of its bibliographic data, Argonne contracted with OCLC for retrospective conversion of its data to MARC format. The data was then loaded into the TECHLIB system. TIS had no previous central repository of transaction or patron records. Those functions were implemented in TECHLIB. The system was implemented in test mode in 1990. It was released for use by Argonne staff in January 1991.

A key requirement in the TECHLIB system selection was adaptability to local needs without the need for customized programming. Therefore, implementation of TECHLIB at Argonne meant that all TIS work processes underwent thorough review. Many TIS work processes were adapted for consistency with TECHLIB workflows, when the system offered a more efficient path to achieving a task. In cases when TIS preferred its own work process to the TECHLIB path, those workflows were evaluated to determine whether adaptation to the TECHLIB workflow, or modification of the system, would provide the greater benefit.

The library system was implemented without the need for customized programming. However, TIS noted that, in order to fully realize TECHLIB's capabilities, operation of the system requires in-house support of a computer systems analyst. The library staff must be knowledgeable about TECHLIB technical functions, as well. TIS reported that library managers and staff need to be fully trained in the TECHLIB system so that the relationships, functions, and workings of the system are well understood.

Since TECHLIB was originally installed in a VAX host-based system at Argonne, the ALEC/TECHLIB system has undergone several major version upgrades. The most significant of these was the migration in 1993 from the VAX platform to UNIX. In 1997 it migrated to the Solaris operating system. The

UNIX implementation was critical as all Argonne business and administrative systems were moving to an open architecture that would be consistent across the entire facility.

Licensed Databases
Argonne acquires Current Contents data from ISI under a license agreement negotiated specifically for Argonne and the University of Chicago. Using IDI's BASIS database product, TIS created and maintains a Current Contents database of journals and journals with abstracts. Argonne and University of Chicago researchers can search the customized database, querying on access points such as author affiliation, table of contents data, and keywords. Once citations have been retrieved, the database points Argonne and University of Chicago users to holdings at their respective institutions; reciprocal borrowing is also supported between the institutions. TIS has further customized the Current Contents database to provide both table of contents and subject-based SDI alerts to users via email, upon receipt of weekly data updates.

Document Repositories
TIS has worked with other ANL departments to put many Argonne text documents, such as laboratory manuals for various projects, on the Web. In order to make these documents fully accessible, TIS manages many of them through a documents database, rather than in purely graphical formats like PDF files. BASIS is the underlying technology support for many of the ANL documents, while others, accessible on the Argonne Web pages, are HTML documents searchable using the Verity search engine.

Web Resources and Electronic Journals
All of the electronic journals available to Argonne users have been cataloged and are included in ALEC. From the bibliographic record in the catalog, Argonne users can hyperlink to the full-text journal on the Web. TIS has recently begun cataloging Web sites that are authoritative resources for research in subject areas of interest to Argonne staff. This enables users to link from the catalog entry for a Web site directly to the resource. Linkage is also possible from a subject-organized HTML document directly, without having to use the library catalog.

CD-ROM Network
TIS also provides access to 18 databases on CD-ROM through a networked system. Some CD-ROM databases can be accessed directly from desktop computers. The rest of the databases can only be accessed from terminals in the ANL libraries.

NEXT STEPS

TIS will be evaluating electronic information resources and their impact on TIS' traditional print collections, licensing, storage, and support issues. TIS plans to integrate internal digital photo, video, and document (image and full-text) collections into its library catalog. TIS expects Web technology and tools to continue to have the major impact on what future enhancements it provides to ANL researchers.

In looking to its future plans for services to Argonne researchers, TIS reported that it would be useful for IDI to develop tools for TECHLIB to support easy integration of all media in one catalog. As IDI further develops the BASIS TECHLIB system with its Web and Windows interfaces, TIS will evaluate

IDI's new version of the TECHLIB system. TIS will determine how the new product fits into Argonne future needs and current standards.

RELATED REFERENCES AND URLs

1. IDI's Web site: http://www.InformationDimensions.com

Sources: Interviews with Shannon Savage, Associate Director, IPD and references cited.

Los Angeles Public Library's Virtual Electronic Libraries

SUMMARY

At Los Angeles Public Library (LAPL) initiatives are underway to increase the Library's reach into the community and to ensure equity of access to information for all Angelenos. In its Virtual Electronic Library project, LAPL is networking electronic resources so that each Library branch can offer far more extensive access to information than is available through the conventional resources in each branch. Over the last two years, LAPL has been developing the telecommunications and systems infrastructure that would allow the Library to deliver its electronic information resources—in any format and from any source, including the Web.

LOS ANGELES PUBLIC LIBRARY (LAPL)

URL: http://www.lapl.org

Los Angeles Public Library serves 3.6 million people, the largest population served by any U.S. public library. Los Angeles is a city of many cultures and languages. The population mix is continually changing as new immigrants come to the city. Even though the Library has 1,100 full-time staff serving the city through the central library, 67 branches, and 4 bookmobiles, LAPL's Strategic Plan notes that some people remain underserved in this complex city of multiple cultures and languages.

According to City Librarian Susan Kent, one critical goal in the Library's strategic plan is to provide equity of access to information to every person in the city of Los Angeles. Numerous initiatives are underway to increase the Library's reach into the community, including:

- opening new and expanded branch libraries, through an aggressive branch construction program (including a new bond measure);
- multilingual marketing initiatives;
- expanded public service hours; and
- outreach efforts to encourage more teenagers and children to use the Library.

To advance the goal of providing equity of access to electronic information resources, LAPL is connecting all Library facilities through a wide area network and implementing a major project called the Virtual Electronic Library.

LAPL'S VIRTUAL ELECTRONIC LIBRARY

In the Virtual Electronic Library project, LAPL is networking electronic resources so that each Library branch can offer far more extensive access to information than is available through conventional resources in each branch. The hub of the Virtual Electronic Library is LAPL's wide area network that connects the Central Library and all 67 branches. Resources available to patrons include:

- The LAPL Catalog of over 5 million items;
- Digitized images from LAPL's extensive collection of historical photographs;
- More than 500 databases, including full-text newspapers and magazines, business directories, health resources, encyclopedias, and other resources, both on the Web and CD-ROM;
- Multimedia software to improve math, reading, and English skills;
- LAPL-created indexes of songs, obituaries, local history information, and other resources; and
- High-speed Internet access.

Currently, all LAPL branches provide free access to Internet searching and to the LAPL catalog. So far, 37 branches have implemented the infrastructure to support expanded access to the resources available in the Virtual Electronic Library. Patrons using these branches have full integrated access to all resources from workstations connected to the network. Many branches have an average of ten public access Virtual Library terminals available to patrons. Patrons accessing LAPL remotely via the Web can reach the catalog, LAPL-created indexes, and the photograph collections.

The LAPL Virtual Electronic Libraries provide access to a universe of information resources that no single Library branch would ever have available, creating effectively a "library without walls." All LAPL branches are funded to implement the project by the end of 1998.

THE TECHNOLOGY SOLUTIONS

The emphasis at LAPL over the last two years has been on developing the telecommunications infrastructure that would allow the Library to deliver electronic information—in any format and from any source—over the Library network and over the Web, using a Web browser to access the network through LAPL's Web pages.

The technology backbone of the Virtual Libraries is the Library's local and wide area network, which uses a client/server Novell Ethernet LAN and WAN solution. LAPL employs a UNIX server to house the Library's Web page. The CD-ROMs and other LAPL databases run on various servers. The CARL System, which is LAPL's OPAC and library management system, employs a Tandem proprietary mainframe. [1] LAPL has successfully integrated access to the Novell network and the CARL System in a way that appears seamless to the general public. With the system of routers and protocol translators that LAPL employs, both the Novell and the CARL protocols can run over the same network.

Today, patrons can walk into many LAPL branches and access all the resources of the Virtual Library, and all LAPL branches will be Virtual Library sites by the end of 1998. As a next step, the Library is exploring how to make its many CD-ROM resources accessible via a Web browser, rather than only on the Library's internal network.

IMPLEMENTATION

The CD-ROM Network

Los Angeles Public Library started developing its CD-ROM network in 1993 with the reopening of the

renovated and expanded Central Library, later expanding it to many of the branches. Although LAPL is migrating from CD-ROM to Web access as database providers make Web versions available, the Library currently has more than 400 CD-ROM databases that it wants to make available equitably to all library patrons, both through Virtual Library workstations in the branches and, pending licensing agreements, to patrons from the Library's home page over the Internet.

For CD-ROM resources, both licensing and technology issues have impeded the Library's ability to open access broadly through the Web. Some vendors, like UMI and Information Access Company, allow LAPL to offer its patrons Web access to databases under the same license as for CD-ROM access, but most vendors restrict Web access. LAPL wants to make its CD-ROMs available to multiple users via the Web, using a Web browser as the interface. Initially, until licensing arrangements are resolved for Web access, LAPL envisions making CD-ROMs accessible in an intranet arrangement, for access only from Library workstations, with outside access allowed on a selective basis.

Another issue for LAPL is the dozens of different interfaces and protocols used by the many CD-ROM vendors represented in the Library's collection. LAPL considers the lack of standard search engines and protocols to be the biggest challenge it faces to integrating its networked resources through a single browser interface. The Library is continually assessing and adjusting the design of the Library's Web pages for handling the new media.

In order to provide intranet or Web access, LAPL is exploring possible solutions from software interfaces such as Ntrigue or WinFrame from Citrix Systems, which would support a variety of workstations, such as Macs or low-end PCs, for accessing Windows applications in a multi-user environment. [2] If it chooses to employ one of these solutions, LAPL would expect to gain several advantages: increased speed and response time for access, and easier set-up and support of Virtual Library workstations as virtual terminals running on a common platform despite hardware and operating system differences.

The CARL System

The CARL System went live as LAPL's library management system in October 1993, when the Central Library reopened following renovations. Full implementation of the CARL System took nearly two years given the large number of LAPL branches. LAPL uses the CARL public access catalog, and the cataloging, circulation, serials, and photo imaging modules.

Through the CARLweb interface, patrons can access the Library catalog and the photograph collections, and can enter other databases and libraries on the Internet. The Library's collection of digitized photograph images are integrated into the LAPL public access catalog, using CARL's Photo Imaging module. In addition to its CARLweb interface for browser access and its character-based interfaces for telnet access, CARL offers highly visual, graphical interfaces that LAPL uses to provide easy-to-use, menu-based systems. Everybody's Catalog presents the Library's holdings through interface that uses vivid icons and graphics. Kid's Catalog is an icon-based interface designed specifically to make it easy for children to use the library's catalog. These interfaces have allowed LAPL to integrate all of its information resources seamlessly into one menu for patrons. LAPL reports that CARL's graphical interfaces are appealing and very easy to use.

The CARL System replaced a first-generation City-developed system that had very limited online capabilities. The Library chose the CARL System because of its ability to handle a high volume of transactions in a multi-branch large public library setting. During the early stages of implementation,

the library placed machine readable barcodes on its 5.5 million items and issued new library cards to approximately 800,000 patrons.

The CARL System has now been supporting LAPL for more than four years. LAPL reports that among the CARL System's greatest strengths are the reliability of the system's Tandem mainframe and the forward-thinking approach the company takes in planning and implementing new products and services. The task of integrating the CARL System with the Virtual Library project was made easier because of CARL's sophisticated Web interface and front-end menuing software.

On the other hand, the Library did not initially purchase CARL's acquisition or serials modules because they were not as extensively developed as the rest of the system. CARL is now developing graphical interfaces for circulation, acquisitions, and serials, and is upgrading the acquisitions module, which LAPL says it may consider in the future. LAPL would also like to see CARL develop Spanish-language and CJK versions of Everybody's Catalog, the graphical interface to the OPAC. CARL has provided a Spanish version for its graphical Kid's Catalog, but so far not for the adult interface.

RESULTS

LAPL reports that the Virtual Electronic Library initiative has impacted every aspect of Library operations. As the first LAPL branches installed Virtual Library workstations, staff training and managing change became key issues as staff experienced the increased complexity of providing library services in the electronic age. As they have enjoyed greater access to information resources, LAPL's patrons' expectations have increased, along with the demand for services.

With 37 Virtual Libraries now operating, LAPL reports that the project has become increasingly rewarding for staff, patrons, and project sponsors. The Library has held virtual dedications to thank the project's donors of private funding, at which the donors have been able to witness the extremely high demand for Virtual Library services from library patrons, ranging from very young children to senior citizens. LAPL indicates that implementation has become more routine now and that the 30 branches scheduled for implementation are anxious to join the ranks of LAPL's Virtual Electronic Libraries.

RELATED REFERENCES AND URLs

1. For more information about CARL Corporation, see the company's Web site at http://www. carl.org.

2. For more information about Ntrigue and WinFrame, see Citrix Systems' Web site at http://www. citrix.com.

Sources: Interviews with Susan Kent and Joan Bartell; LAPL strategic plan and goals statements, and LAPL Web site.

Stanford University Libraries Redesign Workflows

SUMMARY

A team at the Stanford University Libraries (SUL) is working to reengineer and automate many of the technical services workflows. The first work processes to be streamlined were in acquisitions, with support from the SIRSI Unicorn library management system. The results of this redesign are Fast Track monographs processing. Now SUL is addressing serials workflows and EDI transactions. In addition, the Stanford community now has Web access to the OPAC with links to more than a hundred databases and content sources.

STANFORD UNIVERSITY LIBRARIES

URL: http://www-sul.stanford.edu

Stanford University Libraries serves a user community of roughly 14,000 students and 1,500 faculty. SUL focuses primarily on meeting the needs of the Stanford University community, but also operates in the context of library cooperation, with the responsibility to share information as needed outside the Stanford community. SUL works in close coordination with academic computing, called Academic Information Resources (AIR), to implement its agenda for utilizing information technology:

- Use net- and web-based technologies for discovery and retrieval for all formats
- Develop new constellations of digital information and information services for Stanford
- Expand Internet publishing venture, HighWire Press [1]
- Continue and expand support of instructional use of information technology [2]

In addition, SUL launched an ambitious project to reengineer technical services workflows and processes in 1994.

SUL implemented SIRSI Corporation's [3] Unicorn, an integrated library management system, in September 1996. The purpose of this implementation was to replace the NOTIS library system, a change needed to provide the technology support for SUL/AIR's plans. All Stanford students, faculty, and staff can access the new system through Socrates II, SUL's Web OPAC.

Stanford purchased several SIRSI products in addition to UNICORN. These included WebCat, SIRSI's Web OPAC/Z39.50 client, and InfoBase, a Z39.50 server. SUL wanted both the Unicorn system and the Z39.50 tools, because they would support the Stanford libraries in implementing Socrates II, which replaced the original mainframe OPAC. Through Socrates II, SUL will realize the goal of integrating a wide variety of information resources with the desktop tools needed by Stanford users to manipulate the information.

BEFORE SIRSI UNICORN

Prior to the decision to purchase SIRSI's Unicorn library system, a Stanford team had been working for nearly 18 months on an ambitious project to redesign the "acquisition-to-access processes" of the libraries. [4] The project goals were to maintain or improve the quality of service while realizing significant cost savings—a minimum of $750,000—from reengineering the technical processes workflows to remove repetitiveness and increase efficiency. After extensive study and consulting with members of the Stanford community, the Technical Services Redesign Implementation Team recommended a multi-faceted plan that integrates assistance from vendors, technology, and streamlined processes to redistribute tasks where they can be performed most efficiently. For example, book vendors can reduce work for the library by electronically transmitting acquisitions information and providing shelf-ready materials. Within the library environment, the plan called for consolidating the steps needed for local processing of materials and for eliminating any redundant activities.

SUL determined that its investment in systems would produce better returns with new software and new hardware in support of the library management system. In addition, SUL found the prior library management system vendor was not in sync with changes in the mainframe operating systems, which would have cost SUL time and money to make local patches to continue the operations of an essentially outmoded library system. SUL also determined that the prior library management system (NOTIS) and its promised successor system in a new architecture would not provide sufficient function and adaptability for changes in workflow and library operations.

IMPLEMENTATION

SUL installed a test version of SIRSI's Unicorn system in early 1995 for nearly a year of testing while the redesign project continued. The decision to implement Unicorn was made in February 1996, and the circulation, cataloging, and acquisitions functions were up and running by September, replacing all NOTIS transaction activity. Among other accomplishments during this first phase of implementation, patron records and circulation transactions were converted and loaded into Unicorn. Bibliographic, holdings, and items records were converted and loaded, and authority records integrated. Nightly links to Socrates were created for uploading of bibliographic and holdings updates. In acquisitions, active orders were converted and loaded and data links built to transfer paid invoices from Unicorn to the University accounting system. Access to the Unicorn OPAC via the Web-based Socrates II went live for Stanford users in mid-1997. [5]

The next challenges were to modify Unicorn's functionality and user interface to meet SUL's requirements. SUL is working with three book vendors, Yankee Book Peddler [6], Harrassowitz [7], and Casalini Libri [8], to develop links to Unicorn for EDI transmission of acquisitions data for monographic materials, using the EDIFACT standards. As part of a process called Fast Track monograph receiving, these vendors began supplying Stanford with shelf-ready books, which further reduces SUL staff need to handle materials for processing. Stanford is working with Unicorn Application Programming Interfaces (APIs) to accommodate the revised Fast Track workflows through SIRSI's APIs.

In late 1997, Stanford began to address serials control workflow and how these processes should be handled in Unicorn.

STRENGTHS AND LIMITATIONS

SUL reports that among Unicorn's greatest strengths are its open and robust design and the company's philosophy behind the design, which SUL felt was in tune with what it wanted to accomplish. SUL has been able to leverage Unicorn's openness to integrate it with Oracle, which Stanford uses extensively for content management. In addition, SUL is very satisfied that SIRSI is a proven vendor in the field and delivers a mature product that works as it was designed to work. SUL was pleased that Unicorn could provide the modules of functionality and with the manner in which SIRSI worked with Stanford to modify the "out of the box" technology to meet Stanford's needs.

On the other hand, the fact that Unicorn was originally designed for a smaller library environment meant that SUL needed to work closely with SIRSI to bring the system to the research university level of required functionality. SUL and SIRSI both have invested a lot of time and work in creating new tools to meet Stanford's redesign needs. Now SIRSI has taken the result of those efforts into the library market in its new Workflows product.

RESULTS

Since SUL began implementing workflow redesign with the help of the SIRSI Unicorn system, the staff time and cost of handling materials has been reduced. SUL estimates that ultimately it can handle 50-70% of its incoming new books under the new Fast Track model, and that savings of about 15% in technical services staff costs have been realized so far. SUL expects continuous change and productivity gains which will allow resources to continue being reassigned to other uses. SUL reports that the redesign process has often been challenging, particularly for SUL staff that have experienced dramatic changes in the way they work.

For the Stanford community, Socrates II is part of a more extensive Web environment which provides access to over 100 databases through a Web interface, along with greatly enhanced searching features and the ability to manipulate results by e-mailing them or downloading bibliographies into various other applications used by readers.

RELATED REFERENCES AND URLs

1. HighWire Press home page: http://highwire.stanford.edu.

2. Details of SUL/AIR strategic principles, plans and results are included in a paper presented by Michael A. Keller, "'Cybrarians'--The Information Professionals of the 21st-Century," http://www-sul.stanford.edu/staff/pubs/cybrarian.html.

3. SIRSI Corporation home page: http://www.sirsi.com.

4. See the SUL/AIR Web site for documents on this process: http://www-sul.stanford.edu/depts/ diroff/ts/redesign/redesign.html.

5. Stanford's announcement of its decision to implement Unicorn, including early implementation details, can be found in the press release at
http://www-sul.stanford.edu/depts/diroff/unicorn/migruni.html.

6. Yankee Book Peddler home page: http://www.ybp.com.

7. Harrassowitz home page: http://www.harrassowitz.de.

8. Casalini Libri home page: http://www.casalini.it.

University of Pennsylvania Library's Digital Library

SUMMARY

With the Web as foundation, Penn is building a Digital Library that draws together, organizes, and presents a growing variety of electronic resources for desktop access by students and faculty. As the platform for Penn's online catalog, RLIN and other bibliographic databases, the Web provides a front door to digital information and Penn's great print collections. Clarity, ease of use, reliability, and effectiveness are chief qualities that Penn's Digital Library is striving to achieve. Increasingly, the Web provides an integrating medium for the wide range of information the Library makes available in digital form. Penn plans to exploit emerging technologies (e.g., OCLC's WebZ search software, the NISO Z39.50 standard, SDI or search-storing applications) to provide a uniform search architecture, achieve interoperability among disparate systems, and enable users to customize their desktop environments.

UNIVERSITY OF PENNSYLVANIA LIBRARY

URL: http://www.library.upenn.edu

The University of Pennsylvania Library serves a user community of roughly 22,000 undergraduate and graduate students and more than 4,000 faculty. Collectively, the 15 units that make up the Library hold more than 4.4 million volumes, receive 33,500 serials, and house some 2.5 million items in microform. The Libraries add roughly 100,000 volumes per year. Aggressive research at Penn drives faculty and student demand for information to high levels. Thus, in addition to providing significant library resources, Penn also ranks as one of the ten largest interlibrary loan borrowers among the Association of Research Libraries (ARL) institutions. The Library's focus is to provide students and faculty the information they need in any format applicable to their academic work. According to Vice Provost and Director of Libraries, Paul Mosher, the Penn Libraries need to be a "continually adaptive information structure capable of satisfying the huge appetite of Penn Library users for information in all forms." Technology tools that distribute information in ways that suit users' preferences are key to achieving the adaptive structure that Mosher and Penn envision.

To support the university's strategic planning goals, the Penn Library has implemented a new five-year plan. [1] Among other central priorities, the plan seeks the integration of content and technology:

- Create a new paradigm for campus information access by harnessing advanced technology to deliver vast amounts of local and distant information to strengthen and expedite teaching, study, and research.
- Strengthen and maintain the library's technological infrastructure.
- Provide information in all media relevant to Penn's academic programs.

The heart of Penn Library's plan is the drive to create what Mosher describes as a "commonwealth of information," with the Digital Library as the foundation supporting student and faculty scholarship.

PENN'S DIGITAL LIBRARY

The Digital Library is the collection of digital resources resulting from Penn's initiatives to separate relevant information in the "academic domain" from other Internet resources, and to organize and integrate it with Penn's local resources and those shared through consortial arrangements. Penn Library's Web pages provide the front door to this world of digital information. Resources available to Penn users through the Digital Library include:

- Penn's online catalog, Franklin, of more than 2.8 million records;
- Access to RLIN/Eureka and OCLC's WorldCat, and to catalogs of other libraries;
- Databases of journal article and citation indexes, abstracts and full text files;
- Reference information licensed from publishers and from resources available on the Web;
- Electronic journals—more than 1,400 titles from scholarly publishers such as Academic Press and Springer, plus access to JSTOR and other resources;
- Penn Libraries' links to reviewed and categorized Web sites by subject area, an ambitious and growing initiative to present users with guides to reliable Web resources that can be trusted for research purposes; and
- Penn's own Center for Electronic Text and Image (CETI), a collection of digitized imaged and text from several of Penn's special collections archives.

All Penn students, faculty, and staff can access the Digital Library through Penn Library's Web pages using a Web browser like Netscape or Internet Explorer. With the Digital Library's use of IP address restrictions to ensure authorized access, Penn users can access the Digital Library without the need for password sign-on procedures. Penn Libraries are committed to supporting users in ways that allow them to access information in the way most convenient and preferred by the user, from virtually any desktop device, and from any location on or off campus.

THE TECHNOLOGY SOLUTIONS

In order to "satisfy the growing need for desktop access to information, while containing the overhead cost of computing," the Penn Library decided to move from the Library's mainframe NOTIS library system to a new client/server system. Penn Library also needed client/server technology support for a number of its interlinked objectives:

- to provide better integration of local and Internet-based resources,
- to increase user-initiated workflows that would satisfy users' desire for self-sufficiency and help reengineer library staff workflows,
- to optimize desktop delivery capability, and
- to establish new resource-sharing partnerships with other institutions.

In the Penn Digital Library, the Voyager library management system manages and provides access to Penn's online catalog of books and serials. [2] Although Endeavor offers Citation Server and ImageServer products that integrate with Voyager, Penn Libraries did not purchase these products. Penn wanted Voyager primarily for support of the online catalog and for related library staff processes. Voyager took its place as one of several key technology and content components of Penn's Digital Library, in which the Penn Library Web site is the foundation for a host of electronic resources and supporting access technologies.

Access to most of Penn's core citation databases is provided through Ovid Technologies, using either the Web or Ovid's new Java interface, which Penn beta tested. [3] The Library hopes to build Z39.50 links between Voyager and Ovid for the purpose of hooking citation information to serials holdings in the OPAC. Penn Library's Web pages are both the access point for users and the "platform" that enables integration of all the diverse resources and technologies in the Digital Library, through a Web browser interface.

IMPLEMENTATION

The Voyager System

Penn Library implemented Endeavor Information Systems' Voyager, an integrated library management system, in June 1997. Voyager was chosen to replace the mainframe NOTIS library system with new client/server library technology. All Penn students, faculty, and staff can access Voyager through Penn Library's Web pages.

A staff-faculty selection committee chose Voyager from among several competitor systems. At the time, and in Penn's current view, Voyager offered better functionality than others. Also, Penn gravitated to Endeavor because Voyager was the system that best matched the long-term goals for the Digital Library. Endeavor principals' knowledge of the NOTIS mainframe being phased out at Penn was also considered a plus.

The decision to implement Voyager was made in April 1996, and in late 1996 Penn Libraries implemented a test database for training purposes. Endeavor supplied a test database of bibliographic records extracted from Penn's catalog. The full bibliographic database was extracted from NOTIS, and both bibliographic and patron records were converted for creation of the final production file in May 1997. The cutover to Voyager took place in June 1997, and the NOTIS system was decommissioned in September of that year.

The initial Voyager release was a beta version of Voyager 97.1. The Library spent several months collecting user and staff input regarding bugs and functionality, and feeding information back to Endeavor programmers. Gradually, modifications and refinements appeared, the most significant of which was the replacement of the WebVoyage "stateless" client with a "stateful" interface Endeavor calls ConVoyage.

The Penn Library reports that the stateful Web interface is a key Voyager strength. Penn has urged Endeavor to further modify the Web interface for easier navigation. Voyager was highly responsive in improving the basic functionality of the beta product, and is generally sensitive to Penn's feedback of

user needs. The Voyager architecture will support the kinds of ongoing enhancements that Penn is likely to need as it continues to integrate different resources into the Digital Library. Penn Libraries' staff like the ability to import groups of records from bibliographic utilities for editing and easy movement into the system.

Penn was one of the first large libraries (in terms of titles and numbers of transactions) to implement Voyager, which put a load on the Voyager design that had not been tested before. Penn reports that workflows initially slowed down because mouse clicking in the graphical interface was not as quick as using the old command-driven system. Endeavor has been working to reduce the number of screens and mouse clicks needed for moving through data in the staff functions. With its high transaction volume and number of users, Penn found that Voyager needed a faster Web interface. Endeavor developed "stateful" Web software which enables each client's browser to maintain a permanent connection to the server for the session. This change improved response time from sluggish to sub-second.

Licensed Databases

Most of the licensed databases and reference sources that Penn loads locally are supported by the Ovid system. Penn also subscribes to some databases via SilverPlatter. In a special arrangement with ISI, which is located near the Penn campus, Penn Libraries access ISI's Web of Science (known on campus as ISI's Citation Indexes), through a direct link to ISI.

Center for Electronic Text and Image (CETI)

The Center for Electronic Text and Image (CETI) makes available online primary source materials from Penn Library's collections, including printed books, manuscripts, photographs, slides, maps, and sound recordings. Through this ambitious project, Penn has opened access to many rare, unique, and brittle materials in high resolution electronic facsimile. The materials are scanned and digitized and made available on Penn's Web site, using browser plug-ins like Adobe Photoshop and Acrobat, and through Web-enabled CD-ROMs. Scholars accessing the images via the Web can study images at their own workstation, rather than in microfilm or special collections reading rooms. It should be noted that CETI's emphasis is on producing and presenting archival quality images—facsimile reproductions —rather than searchable and encoded text.

The CoPY Project

One of Penn Library's objectives is to speed the delivery of borrowed materials to Penn users, while at the same time reducing the cost of interlibrary loan. In a pilot project called CoPY [4], the libraries of Columbia University, Penn, and Yale University are working with the Research Libraries Group (RLG) and an Australia-based systems integrator, CPS Systems, [5] to create a direct borrowing system among the three institutions. By using a central server and three local servers with linking software, CoPY participants hope to reduce much of the paperwork and staff intermediation of the interlibrary loan process, while speeding delivery of materials to users less than 48 hours from time of request.

NEXT STEPS

One of the next challenges is to modify Voyager's functionality to meet Penn's requirements for the CoPY project. The three CoPY participants are completing functional requirements for the CPS software. Endeavor will be modifying Voyager to support an interface with CPS for real-time transfer of loan information and to support local patron authentication for Penn's users. Endeavor plans to make

its interlibrary loan interfaces available to all Voyager customers. In further development of the Digital Library, the Penn Library hopes to create a common interface for Web access to all Digital Library resources. The Library plans to implement Z39.50 broadcast search capabilities for searching multiple databases and presenting results in a unified format, and is exploring the use of SDI agents for automatically updating searches in areas of ongoing interest to faculty and researchers.

RELATED REFERENCES AND URLs

1. Information Access 2000: A Strategic Plan for 1996-2000. University of Pennsylvania Library, available from http://www.library.upenn.edu/libpubs/plan2000.html.

2. Endeavor Information Systems' Web site: http://www.endinfosys.com.

3. Ovid Technologies' Web site: http://www.ovid.com.

4. For more information on CoPY Project, see information on RLG's Web site at http://lyra.rlg.org/strat/projcopy.html. Further background on CoPY's importance in Penn Libraries' strategy is available in a paper delivered by Penn's Associate Director of Libraries, Patricia E. Renfro, called "The New Service Imperative—Meeting the Information Needs of the Networked Campus," available from RLG's Web site at http://www.rlg.org/globren.html.

5. See CPS Systems Web site at http://www.cps.com.au.

Sources: Interviews with Paul Mosher, University of Pennsylvania's Vice Provost and Director of Libraries, and Roy Heinz, Director of Information Systems; and references cited.

VENDOR PROFILES

Ameritech Library Services

SUMMARY

At the heart of Ameritech Library Services' (ALS) strategy is the company's intention to be a "full-service solutions" provider for libraries. To support its strategy, the company is focused on networking, customer service, and an open design philosophy. Horizon was originally developed in the early 1990s as a PC-based client/server system aimed at special libraries. For the past several years, ALS has been developing Horizon as a system with the level of functionality that would meet the needs of large academic research libraries. Horizon utilizes newer technologies such as scalable client/server architecture and an open design based on a relational database management system. ALS wants to provide whatever solutions libraries may need to secure the library's role as the information hub of the community. In addition to its library systems, ALS offers networking and Internet services, and systems to organize, manage, and access databases and multimedia content. The challenges facing Ameritech in the coming year are to meet commitments to customers for continuing development of Horizon features and capabilities, and to support the Ameritech Corporation's vision of being "the world's premier provider of full-service communications for people at work, at home or on the move." [1]

AMERITECH LIBRARY SERVICES (ALS)

URL: http://www.amlibs.com

Ownership

In 1994, Ameritech Corporation merged its Dynix and NOTIS divisions to create Ameritech Library Services, a subsidiary of Ameritech Corporation and part of its Custom Business Services unit. Company headquarters are located in Provo, Utah, with affiliate offices and distributors in Evanston, Illinois, and in nine other countries.

BUSINESS DIVISIONS/UNITS

ALS focuses exclusively on developing and marketing products and services for libraries and schools. The company recently realigned its internal sales and service operations, moving from organizing around product lines to a geographic territory management model, so that ALS can more effectively cover libraries in each region of the United States and Canada for all products and services.

PRIMARY PRODUCTS AND SERVICES

ALS develops and markets a wide range of interrelated product and service lines for libraries. Many of the company's offerings involve networking and telecommunications technology.

Library Management Systems

- Dynix and Dynix Scholar are character-based library systems that have graphical-user interfaces and some new client/server components.
- Horizon is a client/server library system for UNIX and NT servers, for which Ameritech adopted an open systems design. Horizon will be the focus of this report.
- NOTIS is a mainframe system installed primarily in large academic research libraries and consortia.

Network Services—ALS offers consulting, design, and implementation services for library networks. The company recently announced that it will offer Internet services through its service called NetConnect. Ameritech encourages libraries to identify approved ways to secure and spend monies available to schools and public libraries through the Universal Service Fund.

Information Services—Ameritech offers services to support local loading of databases and a new service called Impart, for Web access to remotely hosted databases.

Conversion Services—Ameritech's Retro Link division offers conversion and cataloging services, including retrospective conversion, MARC database conversion, and copy cataloging.

Add-On Products—Several add-on services are available for ALS library management systems:

- DebtCollect is a collection agency service for pursuing collection for non-returned library materials.
- ENS is an Electronic Telephone Notification System that can be used to notify patrons of materials being held through automated calling.
- TeleCirc is an interactive telephone messaging system for the Dynix circulation module that allows patrons to perform several circulation functions, such as renewing items checked out, listing total fines, and reviewing holds.

Interlibrary Loan. The recently introduced Resource Sharing Automation System, or RSS, is an automated interlibrary loan system that works with Horizon, Dynix, NOTIS, WebPAC, and other library systems supporting ISO ILL standards and Z39.50.

PRIMARY MARKETS

ALS serves all types and sizes of libraries and has approximately 4,200 server installations in school, public, special, and academic libraries, predominantly in the United States. Ameritech reports that, as counted by server installations, Dynix systems are operating in more than 3,500 libraries, mostly public and school libraries, and there are 600-700 Horizon servers installed primarily in medium-sized academic, special, and medical libraries. With the introduction of Horizon, which is based on a scalable, open design, Ameritech expects to attract more large academic libraries. As the company builds more language support into Horizon, it expects to see the number of international customers increase.

OVERALL STRATEGY

ALS's full-service solutions strategy is supported by networking, customer service, and an open design philosophy.

Networking
ALS wants to be the network installer and designer of choice for libraries and to be recognized as the company that knows more about networking solutions than any other in the library market. Ameritech envisions the library system as the core of the library's networking activities. With increased connectivity, Ameritech sees libraries in the role of the community information hub. Ameritech offers networking and Internet services to support this strategy.

A context for ALS's networking services is the company's role as part of Ameritech Corporation, the $16 billion communications company. With the passage of the Telecommunications Act of 1996, the Federal Communications Commission approved up to $2.25 billion annually in discounts on telecommunications services for public libraries and schools. The resulting Universal Service Fund is fed by contributions from all telecommunications carriers that provide interstate telecommunications services. [2] An Ameritech Library Services goal is to help public libraries and schools apply for and spend the funds for which they are eligible. Ameritech provides a variety of telecommunications, networking, and Internet services that qualify for universal service support.

Customer Service
ALS has restructured its sales and support operations in order to become more focused on the needs of its individual customers and to bring back to the company more information about technology and funding trends at a local and state level. Under the new leadership of ALS President Lana Porter, the company has recommitted to customer service as a corporate priority. With a clear focus on customer service and meeting its commitments, ALS intends to stand out from its competitors as a stronger partner to its customer libraries.

Open Design Philosophy
ALS believes it will differentiate itself by adopting a philosophy that moves the company toward a true open systems environment. Ameritech's Porter believes there needs to be more cooperation between vendors in working toward truly open designs that would allow a library to integrate a module or modules from one vendor with the library system from another vendor to achieve the library's choice of functionality. Ameritech expects to enter alliances and partnerships to take advantage of solutions that have already been created by other companies in the industry.

Ameritech's WebPAC product, a browser-based interface, is Ameritech's first three-tier client/server product that works with both Dynix and Horizon, and with any library system that supports Z39.50 access. A strategic goal at ALS is to continue to develop modules that work on both systems and to evolve software engineering efforts to bring the systems closer together over time. ALS reports that it will continue to offer products and services that will work with any standards-compliant system, under the product line name ConnectLIB.

HORIZON

Horizon was originally developed in the early 1990s as a PC-based client/server system aimed at special libraries. Following the folding in of the Dynix and NOTIS divisions to form ALS, the system was named Horizon (it was previously known as Dynix Marquis). In 1995, ALS reached an agreement with the libraries of the University of Chicago and Indiana University to develop the Horizon system to a level of functionality that would meet the needs of large academic research libraries. That joint effort continues today.

Horizon utilizes newer technologies such as scalable client/server architecture and an open design based on a relational database management system. The range of functionality and additional options are not yet as fully developed as for Dynix. Horizon developments are continuing.

Since its introduction, the Horizon system has moved through several major releases and is now in version 5.0. Available modules include: Public Access, Cataloging and Authority Control, Circulation, Acquisitions and Fund Accounting, Serials Control, Reserve Book Room, and Advance Booking. Optional modules are WebPAC; Impart, for remote database access; and Resource Sharing System, for interlibrary loan. Media booking is under development.

The Horizon Approach
Key themes in the Horizon product strategy are its public access capabilities and "patron empowerment" features that allow users to initiate requests without the need for staff intermediation.

Public Access: Horizon development has focused on increasing user interface options. Horizon can be accessed through a Windows client or the new WebPAC browser interface. Through the PAC, patrons can access both the library collection and networked information resources, such as locally loaded databases or hosted databases available via the Internet.

"Patron Empowerment": Users of the Horizon PAC can perform some activities without the need for library staff assistance, such as viewing circulation data, renewing items, and placing holds for items. The new interlibrary loan module, Resource Sharing System, will support direct access and requests from patrons.

HORIZON TOOLS/FEATURES [3]

Architecture
Horizon uses a two-tier client/server architecture, which means the application programs are separate from the database. The Horizon database generally runs on a stand-alone UNIX or NT server, while the application programs run on Windows-based PCs. Client platforms for public access include Windows, Macintosh, and OS/2. WebPAC is the first three-tier client/server product available from Ameritech. Horizon servers can be configured to run WebPAC software so that users can access Horizon, or any Z39.50-compliant database, using any Web browser.

Ameritech's performance testing group sizes the system and server appropriately for each library installation. Horizon is currently running in some small specialized libraries and in libraries with millions of bibliographic records.

Database Management System

Horizon employs a relational database management system (RDBMS), using either Sybase SQL Server or Microsoft SQL Server. The database is completely separate from the applications and runs on a separate server. All modules of the Horizon system access a single set of database files. ALS reports that it is moving Horizon toward being database independent so that other RDBMS will be supported in the future.

Search Engine

The Horizon search engine was developed by ALS, based on Sybase SQL capabilities. Through a graphical user interface, patrons can search using options defined by the library, and the options can be established uniquely for each type of workstation. Search options include combinations of alphabetical title, author, subject, and series searches. Keyword searches are also available. Exact match search options for data elements such as LCCN, ISSN, ISBN, item barcode, or call number can be made available.

Horizon Computing Environment

Architecture	Two-Tier Client/Server; PAC is Three-Tier
Operating System:	
Client	Windows 95 or NT; for WebPAC, any Web browser
Server	Microsoft Windows NT, or UNIX: IBM AIX and OS/2, Sun Solaris, HP/UX, Digital UNIX
Database Management System	RDBMS: Sybase SQL Server or Microsoft SQL Server
Search Engine	Ameritech proprietary
Hardware:	
Client	Any Windows-capable workstation, Pentium with 16MB RAM minimum preferred
Server	IBM RS/6000; Sun; Hewlett Packard; DEC

Network

Horizon is designed to operate on any local area network (LAN) and supports Z39.50 and TCP/IP protocols for network communications.

Standards
Horizon supports USMARC and UNIMARC (for cataloging), EDI ASC X12, and Z39.50. Ameritech is a member of the NAILDD Interlibrary Loan Protocol Implementors Group (IPIG) and has tested interchange of interlibrary loan information based on the ISO 10160/10161 protocol. [4] Horizon is Year 2000 compliant.

Interface Design
Horizon public access clients, which are available for Windows 95 and NT, use standard windowing capabilities such as point-and-click and multiple windows in a graphical display. WebPAC supports access to Horizon via Web browsers using an icon-based graphical interface. The Web client allows libraries to customize the screen to include pictures, backgrounds, and help screens. Also available are interfaces for special users, such as the visually impaired or children.

Security
Security through password access is available in the Horizon Windows client to prevent unauthorized access or changes to data. WebPAC allows users to retrieve bibliographic information without logging into the library system.

Technical Support
Under its new leadership, ALS is focusing intensively on providing strong customer service. As part of its standard support, Ameritech provides implementation profile training, database loading, online documentation, telephone and e-mail help desks, and a Web knowledge base for Horizon customers.

The company has implemented 24-hour, 7-day service by toll-free number and is using several internal customer service tools, such as automatic call distribution, a problem tracking system, and performance measures for managers based on speed of problem response and resolution.

Training and Documentation
Through its "Horizon University" Ameritech offers fee-based training courses in technical and functional aspects of Horizon and in implementation and troubleshooting. A regular schedule of courses is available, with courses held at conferences such as ALA, regional workshops, and at ALS headquarters in Provo, Utah. Courses are available for basic to advanced Horizon system functionality, system administration, and database management, as well as for topics such as integration of Horizon with Web-based resources.

Planned Future Releases
The primary focus on Horizon development has been to make the system's public access components "best of breed." Future developments include completion of the media booking module and adding full Unicode support for diacritics in the cataloging module. Version 5.1 of Horizon will offer security records set-up by user, by module, that will allow the library to determine the level of activity and security required by function. Consortia using Horizon will be able to determine who can modify what portions of both bibliographic and authority records in addition to the basic security functions.

Ameritech reports that future Horizon software will be developed for three-tier client/server architecture, with the middleware—the applications and logic that communicate between user interface and data—running on a separate server.

Horizon Functions Availability

Function	Status	Availability
Acquisitions	Horizon V. 5.0	Now
Cataloging	Horizon V. 5.0	Now
Circulation	Horizon V. 5.0	Now
Electronic Reserves	Horizon V. 5.0	Now
Interlibrary Loan	Resource Sharing System	Now
Media Booking	Future	Future
Serials	Horizon V. 5.0	Now
OPAC	Horizon V. 5.0	Now
Interface to CD-ROM Server	Horizon V. 5.0 using WebPAC	Now
Z39.50 Gateway Search	Horizon V. 5.0 using WebPAC	Now
Full-Text Retrieval	Impart	Now
Full-Text Search	Impart	Now
Graphical User Interface	Horizon V. 5.0	Now
Multimedia Retrieval		
Images	Horizon V. 5.0	Now
Audio	Horizon V. 5.0	Now
Video	Horizon V. 5.0	Now
Bibliographic Records Import/Export	Horizon V. 5.0	Now
Authority Control Import/Export	Horizon V. 5.0	Now
Standards Compliance		
Z39.2 (MARC)	Horizon V. 5.0	Now
Z39.50 (Level 2)	Horizon V. 5.0	Now
EDIFACT	Horizon V. 5.2	Future
Unicode	Horizon V. 5.2	Future
Year 2000 Ready	Horizon V. 5.0	Now

ADAPTING HORIZON TO LIBRARY NEEDS

Overall Adaptability

Horizon was developed with the goal of being highly adaptable to a library's specific needs. Through Horizon technology called MQ Views, libraries can change all parameters of the system to suit local requirements. In addition, Ameritech provides a limited number of Application Program Interfaces (API) for greater access to the system. The company plans to add more APIs for use by those libraries that have technical resources available to take advantage of them.

Support for Effective Workflows

Data Interfaces: The Horizon system supports both USMARC and UNIMARC formats. Catalogers may import MARC formatted bibliographic and authority records from external sources such as bibliographic utilities; the Horizon system provides for automatic error checking as records are imported. Authority headings may be exported for updating by external cataloging utilities, then imported back into Horizon.

Horizon is compliant with ASC X12 for EDI transmission of serials orders, claims, and claims responses. Ameritech plans to add new X12 transactions, widening the range of messages and options available. The company will support EDI transactions through a VAN (Value Added Network) if the library or vendor prefers.

Local Processing: Ameritech has introduced an interlibrary loan system called Resource Sharing System (RSS), which can be used as a standalone system or with Horizon with access through WebPAC. RSS has been designed to automate interlibrary loan processes for staff and will allow patrons to make their own requests directly through the system, if the library chooses to implement this option. Also at the library's option, patrons may view their circulation information through the PAC and renew and request items themselves.

The cataloging module provides a full-screen editor for updating MARC records, with editing features that use standard Windows features such as cut-and-paste, window sizing and placement, and mouse functions.

Migration/Transition: As mentioned above, Horizon supports import of bibliographic and authority records in MARC format to aid libraries in moving to Horizon from other library systems. ALS will migrate all data that a library can extract from its current system and that can be mapped to Horizon's data structures, which is dependent on the level of standardization between systems.

STRATEGY FOR NETWORKED INFORMATION

As mentioned earlier, networking is important to ALS's strategy in the library market. As a full-service solutions provider, the company wants to provide whatever tools and resources libraries may need to secure the library's role as the information hub of the community. In addition to its library systems, ALS offers networking and Internet services, and systems to organize, manage, and access databases and multimedia content.

From the Horizon PAC, library patrons can launch text, image or audio files from a bibliographic record using 856 field links. Ameritech's Impart online database service (formerly Vista II) provides standalone or access via the Horizon WebPAC to a number of databases that can be licensed through ALS.

Support for Emerging Data Formats
At the corporate level, Ameritech's support of digital library initiatives is well known as a result of its $2 million gift to establish the Library of Congress/Ameritech National Digital Library Competition.

At the product level, ALS offers a digitization solution called ALS Media Server. The Media Server provides support for the capture, storage, and retrieval of multimedia content, which can be linked to a library's MARC database, via 856 tag link, for access through the PAC.

Support for Electronic Payments
ALS reports that functionality is being evaluated to support payments by individual users for document delivery or other on-demand transactions.

PRODUCT DEVELOPMENT INFRASTRUCTURE

Product Development and Enhancement
Ameritech reports that the following principles guide product development:

- the customer is the "director" of the development effort,
- the company intends to use modern industry-standard tools for development, and
- the company's products should have consistency in their user interfaces.

Ameritech gathers input for product enhancement by listening to feedback from the Horizon user's group and through the users' group listserv. The company hosts regular meetings as a forum for interaction with its users groups. In addition, Ameritech managers meet with library directors to learn about libraries' strategic direction and trends. The company's reorganization of sales and support into customer-focused territories is intended to bring a great deal more information back into the company for product planning purposes.

Product Development Partnerships and Technology Licensing
For use in Impart, the online database access service, ALS licensed the ProIndex search engine from InfoSphere, Inc., a specialist in full-text indexing and retrieval technology. [5]

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

Since the acquisition and merger of Dynix and NOTIS formed Ameritech Library Services in 1994, ALS has acquired no other companies.

CORPORATE ORGANIZATION AND OFFICES

Corporate Headquarters and North American Offices
Ameritech Library Services
400 Dynix Drive
Provo, UT 84604
Phone: +(1) 801-223-5200; +(1) 800-288-8020
Fax: +(1) 801-223-5202

Ameritech Library Services
1007 Church Street
Evanston, IL 60201
Phone: +(1) 847-866-0150
Fax: +(1) 847-866-0178

Ameritech Library Services (Canada) Inc.
One Blue Springs Drive
Suite 101
Waterloo, Ontario NJ2 4M1
Canada
Phone: +(1) 519-885-6040
Fax: +(1) 519-747-4262

Sales, Distribution and Support
Ameritech Library Services sells and supports its products and services through its own direct sales force. The company recently reorganized the sales force in North America into a territory management model, aligned to ten geographic regions in the U.S. and Canada. Each region is covered by a team of field sales reps and inside account and service reps.

In addition to its direct sales force in North America, Ameritech supports sales offices and distributors in Saudi Arabia, Australia, France, Germany, Ireland, the Netherlands, Mexico, and the United Kingdom.

Company Executives
Lana Porter, Chief Executive Officer
Rick Lawhun, Chief Financial Officer
Patricia Gaulin, Vice President, Sales
Carl Grant, Vice President, Marketing
Tyler Gingrich, Vice President, Engineering
Roy Williard, Vice President, Customer Service

FINANCIAL STATEMENT

In 1995, Ameritech Library Services earned a record $111 million in revenues. The company reported that 1997 revenues were over $90 million. Fiscal year ends: December 31 (Ameritech Corporation).

RELATED REFERENCES AND URLs

1. For a statement by the Chairman and CEO of Ameritech Corporation of the synergy between the parent company and Ameritech Library Services, see "Ameritech's Commitment to Library Services," at http://www.amlibs.com/company/news/1998/commit.htm.

2. For background on the Universal Service Fund, ALA has created a site with information and links related to the Telecommunications Act of 1996, available at http://www.ala.org/oitp/uniserv.html.

3. For a detailed description and discussion of Horizon characteristics see William Saffady, "Vendors of Integrated Library Systems for Minicomputers and Mainframes: An Industry Report, Part 1 [Ameritech Library Services]." *Library Technology Reports* 33, no. 2 (March/April 1997): 143-159.

4. For more information about the North American Interlibrary Loan and Document Delivery (NAILDD) Project, see http://www.arl.org/access/naildd/naildd.shtml.

5. For more information about ProIndex, see InfoSphere's Web site at http://www.proindex.com.

Sources: Interviews with Lana Porter and Tyler Gingrich; Horizon functional overview; and Ameritech Library Services Web site.

CARL Corporation

SUMMARY

Partnerships with libraries and flexibility are key themes at CARL Corporation. CARL's overall strategy is captured in the company's message "Access for All," which underscores CARL's mission: to create innovations that empower the library user and help libraries serve their users. CARL supplies library systems to large urban libraries, large academic systems, and multi-type consortia. The CARL Library System provides complex functionality necessary to support large institutions as well as the numerous variations in policies and procedures found in consortia. CARL has created unique content and technology-based products in its twenty years, including UnCover, for article access in the online catalog; NoveList, for reader's advisory services linked to library holdings; and Kid's Catalog, a graphical user interface to children's collections in libraries. A traditional CARL strength is providing networked access to information. CARL remains committed to the Tandem hardware platform and is restructuring its software to run under Tandem's version of the NT operating system, to make the system more accessible to smaller institutions. In the year ahead, CARL's challenge will be to implement successfully the NT environment through a process of "revolution through evolution," so the new system will both appeal to new customers and avoid disruption or a cost burden for current customers. Also during the year it is likely that CARL will be acquired and make adjustments resulting from joining a new parent organization.

CARL CORPORATION

URL: http://www.carl.org

Ownership

CARL Corporation is a wholly owned subsidiary of the Dialog Corporation. [1] The Dialog Corporation was formed in November 1997 from the merger between Knight-Ridder Information (KRII) and M.A.I.D., plc. As of January 1998, Dialog Corporation was in the process of qualifying purchasers for CARL Corporation, which is being recombined and offered with the UnCover Company and the patent delivery business that was formerly provided by KRII's SourceOne.

BUSINESS DIVISIONS/UNITS

CARL's corporate headquarters are located in Denver, Colorado. CARL operates four key businesses under the CARL umbrella:

- Integrated Library System—the library management system business based on the CARL System and related offerings;
- Databases
  - UnCover—an Internet-based periodical index and document delivery service containing over 7,000,000 citations;

- Dialog@CARL—a Web interface to 300 of the Dialog databases, designed for academic libraries;

- Document Delivery Services—article, document, and patent delivery from the UnCover database; and
- NoveList—a CD-ROM and Web-based readers' advisory database, which provides subject access to over 52,000 fiction titles for adults, young adults, and children.

CARL also maintains a Contract Services division that provides integrated library systems management services tailored to individual library needs.

PRIMARY PRODUCTS AND SERVICES

Within its flagship CARL System product lines, CARL provides several key products:

CARL Library System—a client/server based, integrated library management system, which has been fully functional for 16 years and is currently being enhanced through new Web-based and Windows interfaces. CARL Corporation has announced its decision to port the system to the Windows NT platform. The CARL Library System will be the focus of this discussion.

Kid's Catalog—a graphical user interface that supports access to library collections for children. Kid's Catalog is available as a module of the CARL Library System and is also licensed to other library system vendors.

Everybody's Menu-Builder—a graphical security and menu management tool that supports custom menus and security options for libraries' public access workstations.

PRIMARY MARKETS

For its library system, CARL has traditionally targeted large, multi-site public libraries, with an emphasis on large urban public libraries, consortia, and university systems in the United States. CARL's customer base includes over 640 libraries at 36 sites, including public libraries and library consortia, public school library systems, and academic libraries. Together, CARL's customer libraries serve over 30 million users. To date, CARL has no international sales but has begun bidding selectively on systems in Asia and Australia.

A measure of CARL's appeal to large, complex networked library systems is CARL's presence in large regional and urban libraries including Chicago Public Library, Los Angeles Public Library, Houston Public Library, San Antonio Public Library, Atlanta-Fulton Public Library, Denver Public Library, and Baltimore County Public Library. CARL serves three of the four largest libraries in the country—Chicago, Los Angeles, and Houston.

As CARL moves to the NT platform, the company expects the new downward scalability of the system will make it attractive and more affordable for small-to-medium public libraries, extending to smaller institutions the strength of functionality that CARL offers.

OVERALL STRATEGY

CARL's overall strategy is captured in the company's theme "Access for All." This theme underscores what CARL sees as its mission: to create innovations that empower the library user and help libraries serve their users.

The company's goal is to provide innovative software applications, state-of-the-art networks and intuitive, user-friendly information management interfaces for libraries and library users. By committing to an open system architecture, CARL wants to enable users of all library systems to take the best of what is available in library technologies—whether in CARL products or those of other vendors—and integrate it into their own systems.

Once its library system is operating in an NT environment, CARL will have the opportunity to consider different packagings of the system for different applications. It will also give CARL more options for integration of both technology and content-based third-party products. The company envisions these developments opening different segments of the market for the CARL system.

Partnerships with libraries and flexibility are key themes at CARL Corporation.

Partnerships
CARL has always established development partnerships with libraries as a central strategy. The CARL system grew out of the Colorado Alliance of Research Libraries resource-sharing consortium. Other large multi-type library consortia were also attracted to the CARL formula. CARL defines itself as a powerful ally in helping the library to offer interesting new services that help keep the library lively and responsive. CARL's award-winning graphical user interfaces, imaging products, Internet gateway server, and electronic information services, have all been developed in partnership with its customer libraries. The ideal CARL/customer partnership is based on a shared vision.

Flexibility
The CARL Library System offers flexibility in set-up, configuration, and use. The system allows each library to establish its own policies and procedures through parameter settings. CARL works closely with each library throughout the installation process.

CARL's CEO, Ward Shaw, acknowledges that CARL's development emphasis has always been oriented toward end users. However, with the increased attention focused on workflow issues in libraries, the company has recently concentrated on products that address library staff needs in the areas of acquisitions, serials control, cataloging, and circulation. CARL is developing new client/server-based interfaces to these staff functions which will allow existing CARL customers to move to the new interfaces as budgets allow for the retirement of character-based terminals.

CARL LIBRARY SYSTEM

The CARL Library System was developed 16 years ago and has been updated and enhanced with regular releases since that time. For the past two years, CARL has been systematically re-engineering the software to maximize client/server functionality and to prepare for porting to an NT platform.

Unlike other vendors, CARL has not given its new client/server-based system a new name. CARL considers development of the new GUI clients and the migration to a new operating system to be an evolution that builds on the existing system, rather than development of a totally new product. The refreshed CARL system retains "The CARL System" branding.

CARL LIBRARY SYSTEM TOOLS/FEATURES [2]

Architecture

The CARL Library System uses a three-tier client/server architecture running on a Tandem computer platform, a hardware platform that CARL has employed from its beginning. The Tandem platform, which supports the industry standard POSIX (Portable Operating System Interface for UNIX), provides a scalable system to support medium-sized to very large libraries. The Tandem platform is known for its reliability and scalability. It was designed for online, high-transaction environments, and is most often used by industries that do not tolerate downtime. Today Tandem computers support 90% of 911 calls nationally, 80% of the world's stock transactions, and 66% of ATM transactions. CARL uses this technology to provide high performance and high reliability to its customers.

For CARL, Tandem's acquisition by Compaq has been significant, as the acquisition will allow Compaq to get into the high-end server business. The partnership with Compaq, Tandem and Microsoft to develop very large-scale NT platform capabilities suggests to CARL that its decision to stay with the Tandem platform is a wise one for CARL and its customers that have invested in the Tandem platform. A unique feature of the CARL/Tandem combination is that the operating system is priced per system, not per user. As the system grows, there are no additional "seat" charges for additional users of the system or the DBMS.

CARL has made a firm commitment to porting and restructuring the entire system to an NT platform, but progress has been slowed by NT's current inability to handle the high transaction volume required by CARL's traditional customers—large public libraries. To date, there is not an NT server capable of running a system the size of Los Angeles Public Library, according to Ward Shaw, but CARL expects Compaq/Tandem to produce the industry's first such server.

Database Management System

Most of the CARL database is managed by Tandem Enscribe, a relational database management system (RDBMS). The NT components of the CARL system, including all of the new applications, are in Structured Query Language (SQL)-compliant database structures. CARL is exploring relations with third-party vendors and products to support object-oriented system design and enhanced searching capability.

Search Engine

The proprietary CARL search engine supports keyword Boolean searching, right-hand truncation, and alphabetical and numerical browsing and sorting. Searches can be qualified by date, language, and format. The data structures support left-hand truncation and phrase or adjacency searching, but as yet CARL has not addressed these capabilities in the interface.

Network

The CARL system uses standard TCP/IP protocol for most data communications. The system also runs Tandem's Expand telecommunications software for private point-to-point networking. No additional operating system overhead is required. All maintenance and software upgrades are handled over the closed Expand network connection between CARL's Denver offices and the library site.

CARL offers network planning, engineering, and implementation services to assist customers in identifying the most cost-effective reliable network options. Services include:

- LAN consulting,
- WAN engineering and implementation,
- System integration and consultation,
- Network performance analysis,
- Network management consultation, and
- On-site training.

CARL System Computing Environment

Architecture	Three-Tier Client/Server
Operating System:	
Client	Staff clients: Windows 95 or NT, or CARLweb CARLweb client can be used with any Web browser.
Server	Tandem (POSIX-compliant)
Database Management System	RDBMS: Tandem Enscribe
Search Engine	CARL Proprietary
Hardware:	
Client	Staff client: Pentium class PCs OPAC client: Any workstation that can support a browser.
Server	Tandem

Standards

CARL is committed to standards-based development and supports the suite of Z39 standards, MARC, and EDI. The company reports that Unicode support is a high priority development effort. CARL is a member of the NAILLD Interlibrary Loan Protocol Implementors Group (IPIG) and is working on support for the ISO 10160/10161 protocols.

Security
All CARL staff modules are password protected. The level of access allowed is driven by the password, so for example, the password for a clerk in the acquisitions department would allow for a lower level of access than the password for a supervisor. Menus are displayed appropriate to the access level of the password entered.

For the public access catalog, there are no restrictions on access. Access to commercial databases via the CARL client, Everybody's Catalog, are password protected using CARL's proprietary UVAL validation software. Access to commercial databases over the Internet, via CARLweb, can be IP filtered.

Interface Design
CARL is known for its PC-based graphical interface products—Kid's Catalog and Everybody's Catalog. These highly visual interfaces have been designed to work in combination with the CARL system or with any other library system on the market. The company has expanded this line to include a Web-based OPAC called CARLweb, and Web interfaces to NoveList and UnCover. CARL has also licensed The Library Corporation's ITS Cataloging Workstation which was modified to support CARL file structures.

Technical Support
The Online Support Center (OSC) and Rapid Response Team (RRT) address software, hardware, or network problems. The OSC is staffed 7 a.m. to 6 p.m. MST. Staffing combines troubleshooters who can evaluate software, parameter, hardware, and network interactions. The team consists of a core group of senior analysts and technical support staff who have available a rotating crew of programming, quality assurance, and network support staff. This approach attempts to harness the knowledge and expertise of CARL staff across all disciplines.

The RRT uses an automated call management system, which CARL calls Top of Mind (TOM). Each call is assigned a case number used as reference key for any follow up communications. As a "knowledge database," TOM is designed to help identify and address repetitive problems quickly by recording known fixes and making them readily available online for dissemination by RRT staff.

CARL reports that the implementation of the Response Team concept reflects a national trend in which technical support call centers and help desks are being merged into "integrated service" desks. By concentrating resources available in the OSC where the call comes in, CARL intends to provide the most direct and rapid turnaround for the broadest possible set of critical issues.

Training and Documentation
When CARL implements systems for new customers, it provides on-site training for system administrators and operators, and module-by-module applications training. CARL also schedules update workshops for existing customers that focus both on system operation and functional applications. Workshops are held in the Denver offices and at CARL system sites throughout the United States.

Full documentation is integral to each new software release. In addition, CARL issues release notes to all current customers and makes them available at its Website.

Planned Future Releases

CARL's technology plan is to complete the suite of graphical interfaces for staff and public use as a first priority. These are being programmed in C++, as is the software that supports them on the Tandem host. The next phase of development will be to write a new "backend" to the system that will include enhanced searching features and support for multiple platforms, including NT and Tandem. This will allow the new CARL System to support additional functionality and scalability to make it more affordable to smaller libraries, while still allowing support for large institutions. With its phased approach to implementing the NT platform, CARL anticipates that its libraries can maintain their investments in Tandem computer hardware, while moving in the future to an NT environment without having to retrain staff or convert to a new system.

CARL is currently developing graphical interfaces for Circulation, Acquisitions and Serials, to complete the graphical interfaces for the system's staff support modules. The interfaces use industry standard RPC and DCE interfaces for communication between the PC client and the host server. With these industry standard protocols, CARL hopes to ensure excellent response time. The standards allow CARL developers to use rapid development tools and build upon the strength of the existing file structures.

CARL's "Year 2000" code (Y2K) is scheduled for release in March 1998. With the cut-over to the new release, for the first time all CARL customers will be running on the same version of the code concurrently. CARL has ongoing development in Unicode, which will allow support for non-Roman alphabets. CARL hopes that this approach will build intelligence into the handling of foreign languages and allow the company to use a concept approach to indexing rather than a character-by-character approach.

CARL's client/server architecture incorporates a "thin client" design for current PCs as well as future Network Computer hardware options. In the thin client, the business logic resides on the server. For instance, circulation parameters reside on the server. The interface and library customization features reside on the client. Only data is sent back and forth. One advantage of this is that updates to data can be done centrally, one time. The software is optimized for 32-bit Windows 95 or Windows NT operating systems.

ADAPTING THE CARL SYSTEM TO LIBRARY NEEDS

Overall Adaptability

The CARL Library System provides complex functionality necessary to support large institutions as well as the numerous variations in policies and procedures found among consortia member libraries. The system, in line with CARL's philosophy of partnered development, supports a high degree of library customization. CARL has always made source code available to library customers and provides APIs into the system. This policy will continue in the NT environment. CARL believes that marketing library systems for the 21st century is going to be about "individualizing." The CARL system makes extensive use of parameters and switches to give libraries a full range of functional options. CARL recognizes that some innovative customization still requires actual programming changes.

CARL System Functions Availability

Function	Status	Availability
Acquisitions	CARL System *GUI in development*	Now *March 1998*
Cataloging	CARL System/ ITS for CARL	Now
Circulation	CARL System *GUI in development*	Now *March 1998*
Electronic Reserves	CARL System	Now
Interlibrary Loan	In development	1998
Media Booking	—	—
Serials	CARL System *GUI in development*	Now *March 1998*
OPAC	CARL System	Now
Interface to CD-ROM Server	CARL System/ CARLweb	Now
Z39.50 Gateway Search	CARL System/ CARLweb	Now
Full-Text Retrieval	CARL System/ CARLweb	Now
Full-Text Search	CARL System	Now
Graphical User Interface	CARL System	Now
Multimedia Retrieval		
Images	CARL System	Now
Audio	CARL System	Now
Video	CARL System	Now
Bibliographic Records Import/Export	CARL System	Now
Authority Control Import/Export	CARL System	Now
Standards Compliance		
Z39.2 (MARC)	CARL System	Now
Z39.50	CARL System	Now
EDIFACT	CARL System	Now
Unicode	In development	Q2 1998
Year 2000 Ready	In development	March 1998

Commitment to an open architecture is important for CARL as the company believes that more and more systems will be constructed dynamically with both content and technologies pulled from other networks. Open systems will allow CARL customers tools to customize their systems down to the desktop and allow users of other systems to fold CARL products into their own environments. The CARL goal is to provide libraries the tools and the support to integrate their own systems.

Support for Effective Workflows

Data Interfaces: The CARL System supports electronic links to a variety of book and serial vendors for transmission of ordering, claiming, invoicing, and bibliographic record download. CARL currently supports ordering of materials in ASC X12 and BISAC standards, using FTP, direct dial-up, and connections through a Value Added Network (VAN).

Local Processing: The new graphical staff clients build on the functionality of CARL's character-based Circulation, Serials, and Acquisitions modules, while taking advantage of the workflow enhancements available through a graphical interface. CARL is designing the clients to support user preferences for pointing devices, keyboard navigation, and efficiency of operation depending on task-specific requirements. All modules are designed to increase productivity, reduce training needs, and minimize maintenance with easy network updating of the client software.

CARL licensed The Library Corporation's ITS for Windows Cataloging Workstation and adapted it to become the CARL Technical Services Workstation. The Workstation is fully integrated with CARL system software and databases. It supports original cataloging, copy cataloging, and catalog maintenance for MARC bibliographic and authority records, as well as community information files.

Users can search multiple database sources such as bibliographic utilities, Z39.50 sites, CD-ROM databases, and book suppliers, as well as CARL template and authority files. The Workstation features a full-screen MARC editor with cut, copy, and paste capabilities, as well as tag level context-sensitive help. Multiple search/edit windows support ease of data comparison across sources. Full diacritic displays, authority verification, MARC record validation and format integration are standard features. Included with the Technical Services Workstation is the Cataloger's Reference Shelf, an electronic library of MARC manuals and code lists in Windows hypertext format for online reference. A macro scripting language is also provided for automation of repetitive tasks.

Migration/Transition: CARL supports both import and export of MARC-formatted bibliographic and authority records. Interfaces with OCLC support FTP, batch load, and other import/export routines for moving records into the CARL System.

STRATEGY FOR NETWORKED INFORMATION

CARL was an early pioneer in supporting networked information access and can point to a series of "firsts" in this area. Along with the University of California system, CARL was the first library system to make itself available as a host on the Internet. CARL's UnCover was the first to support credit card transactions over the Internet. CARL was the first to integrate commercial databases on local library systems. CARL was among the first systems to integrate image management into the public access catalog. Support for electronic commerce, copyright management, desktop delivery of

images in a choice of formats, alerting services, and publication-on-demand are services CARL is integrating into its own software to help libraries manage better in the networked environment.

Ward Shaw, CARL's CEO, believes library automation vendors are not likely to invent core technologies. Rather, Shaw believes wise libraries and their vendors will follow a "slip stream" approach where they smartly position themselves behind key innovations and allow themselves to be pulled along in their wake.

Support for Emerging Data Formats
The CARL System is compliant with Z39.50 for both the client and the server, and through CARLweb, enables libraries to use a graphical interface to perform Z39.50 gateway searches of Z39.50-compliant library catalogs and databases on the Internet.

CARL's Photo Imaging Module allows libraries to scan and link images to bibliographic records for patron access through the OPAC. Image databases on the Web can be accessed by library users through CARL's graphical interfaces, CARLweb and UnCoverWeb.

Support for Electronic Payments
As mentioned above, CARL supports payments by credit card for individual users of UnCover. Through the CARL system, libraries can offer access to licensed commercial databases with the support of patron validation procedures for access from remote locations.

PRODUCT DEVELOPMENT INFRASTRUCTURE

Product Development and Enhancement
CARL's relatively small customer base and informal product development infrastructure encourage product enhancement ideas from customers. Ideas also come from customer service and application support staff. Each year, CARL holds a User Group meeting and a Director's Meeting at which new products and services are discussed. The Director's Meeting also focuses on strategic direction and future planning. Both meetings provide input into the product development process and the prioritization of product enhancements.

New product ideas also come from the sales process, from responses to procurement requests, from the suggestions of automation consultants, and from close monitoring of market trends. Once an idea is conceived, the next step is generally a formal specification process. After specification, CARL uses a process it calls "test marketing by prototype" in which a library site (or sites) is selected to use the prototype in its very early stages and contribute suggestions for its design and functionality. At the end of this process, documentation is written, and additional beta test sites are selected.

Development Partnerships and Technology Licensing
In addition to its library development partners, CARL seeks development alliances with other organizations and vendors. In 1997 CARL entered into an alliance with the Research Libraries Group to develop and market a Web-based interface to the Dialog and CitaDel databases. [3] As mentioned earlier, CARL has licensed the ITS workstation from The Library Corporation. CARL has licensed its

own Kids Catalog to a number of other vendors, including Ameritech. CARL is a value-added-reseller for Tandem, Compaq, Cisco, Hewlett Packard, and Sun Microsystems.

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

CARL Corporation acquired NoveList from its owner/developers Duncan Smith and Roger Rohweder in 1992. The following year, CARL spun off UnCover into a separate company, jointly owned by CARL and BH Blackwell, of Oxford, England. CARL and UnCover were acquired by Knight-Ridder Information in 1995 and then sold to M.A.I.D., plc (now the Dialog Corporation) in 1997. As mentioned earlier, CARL, UnCover, and the SourceOne patent business are being recombined and offered for sale as a unit by Dialog.

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Sales, Distribution and Support
CARL maintains a field sales force of three, based in Denver. All customer and technical support is also provided from the Denver office.

Company Executives
Ward Shaw, Chairman and CEO
Rebecca Lenzini, President and COO
Patricia Culkin, Senior Vice President
John Duffy, Chief Financial Officer

FINANCIAL STATEMENT

CARL did not release revenue figures. Fiscal year ends: December 31.

RELATED REFERENCES AND URLs

1. See Dialog Corporation's Web site at http://www.dialog.com.

2. For a detailed description and discussion of CARL Library System characteristics, see William Saffady, "Vendors of Integrated Library Systems for Minicomputers and Mainframes: An Industry Report, Part 1 [CARL Corporation]." *Library Technology Reports* 33, no. 2 (March/April 1997): 171-183.

3. For information about RLG and CitaDel, see RLG's Web site at http://www.rlg.org.

Sources: Interviews with Ward Shaw, CEO, and Don Kaiser, Director of Technical Sales; product literature and information from the CARL Website.

Data Research Associates, Inc.

SUMMARY

Three strong threads run through Data Research Associates' (DRA) strategy: new technologies, multilingual system, and customer interaction. DRA has committed to object-oriented computing, and to that end is developing a new library management system called Taos. The Taos system employs multi-tiered client/server architecture, an object-oriented database management system, and a CORBA-compliant object request broker to support fully distributed processing. The use of Unicode throughout Taos allows for full multilingual support in user interface, data display, and indexing. DRA believes the key to remaining competitive in today's market is embracing totally new technologies and that this commitment has put DRA ahead technologically. DRA serves academic, public, school and special libraries. The initial target market for Taos is libraries that will lead in early adoption of new technology solutions. DRA's challenges for the upcoming year include selling the benefits of using an object-oriented database management system, which has not been offered in library automation before, and securing a base of initial Taos customers that are not only early adopters, but who will also provide a solid reference base for mainstream libraries.

DATA RESEARCH ASSOCIATES, INC. (DRA)

URL: http://www.dra.com

Ownership

Founded in 1975, DRA completed an initial public offering (IPO) in 1992 (NASDAQ: DRAI). The company is headquartered in St. Louis, Missouri. Company founder Michael J. Mellinger serves as CEO and President.

BUSINESS DIVISIONS/UNITS

DRA's primary business is library automation—software, service, and, to a lesser degree, hardware. The company's networking group derives a very small proportion (about 1%) of its sales from business Internet services, and those are heavily tied back into libraries. For example, the business Internet unit sells Internet service to the Library of Congress. DRA is the only publicly held company devoted solely to library automation.

PRIMARY PRODUCTS AND SERVICES [1]

DRA produces and supports four library systems, with some overlap between them:

DRA Classic—DRA's original integrated library system, which the company has been installing and enhancing for about 18 years. It has the largest share of DRA's current business. DRA also owns and

supports two additional library management systems: **MultiLIS** and **INLEX**, neither of which DRA actively markets.

Taos—DRA's next generation system. A new system that builds on the functionality of DRA Classic, MultiLIS, and INLEX systems, Taos is a client/server, object-oriented system. Only the public access catalog, Web2, is currently in release. Although it is designed to be used with the Taos server, Web2 will run against both the DRA Classic and the MultiLIS servers. DRA reports that Web2 is now being used by approximately 20 current customers. All additional Taos modules are in development, with full release anticipated for sometime in 1998. DRA's strategy as encompassed in the new Taos system will be the focus of this report.

PRIMARY MARKETS

DRA reported that it has 800 system installations, which cover about 2,300 individual libraries. The breakdown of DRA's customer base is 40% academic, 40% public, 15% school, and 5% special libraries. The company says this mix has been fairly stable for the past decade, except that school library market penetration has increased tangibly with the acquisition of the MultiLIS system.

DRA believes that its school library business will increase somewhat. It has been difficult to offer high quality solutions to the K-12 marketplace for financial and networking reasons. Traditionally schools have had individual one-user PC-based systems and have not received the same advantages of system-wide integration enjoyed by public and academic libraries. With the price of systems coming down and most schools becoming wired, the school market is becoming more attractive to DRA.

DRA has some current market share outside the U.S. and Canada and expects to expand further into overseas markets with the release of Taos, which is a multilingual product.

OVERALL STRATEGY

DRA's CEO, Michael Mellinger, asserts that library automation has become commoditized and that the key to remaining competitive in today's market is embracing totally new technologies. In his estimation, the company's commitment to emerging technologies, such as CORBA and object-oriented design, have put it out in front of other vendors technologically.

DRA's stated goal is, "When a library patron uses our system, they'll find what they're looking for." Three strong threads run through DRA's strategy:

New Technologies
The new Taos system will be a complete replacement for the existing systems, but based on the concepts DRA has learned in its 22 years in the business. The architecture is based on a multi-tier client/server approach. Taos uses CORBA and object-oriented computing. Taos will be platform independent and able to run on UNIX and NT operating systems. The design supports both C++ and Java objects.

Multilingual System

As Taos is based on Unicode and native indexing, DRA believes this multilingual support will make Taos attractive to overseas markets. Users in the same library at different workstations will be able to use the system in whatever languages they choose. Taos provides multilingual support for the user interface, data display, and indexing. DRA's new Web2 product was released simultaneously in English, French and Spanish. The DRA user display is multilingual; for example, on the same screen a user will be able to have Chinese, Polish, Russian, or combinations. The display is totally independent of the user interface. Instead of normalizing and Romanizing searches, Taos will use native files for searching.

Customer Interaction

DRA sees a high level of customer involvement as key to the development process. DRA reports that it works closely with libraries to develop its new systems and relies on them to understand the end users' needs. Taos is being created with the assistance from librarians on DRA's own staff, together with a committee of DRA User Group members, who were chosen to represent leading public, academic, school and special librarians.

TAOS

The initial target market for Taos is technology leader libraries. Even though Taos is still under development, it has already been purchased by three large academic institutions: UCLA; University of California, Santa Barbara; and the ILCSO group of 43 academic libraries and the state library in Illinois. ILCSO is a 2,100 user system distributed throughout the state.

Currently only the Taos public access catalog has been released. DRA plans full release of circulation, cataloging, acquisitions, and serials during 1998. In addition, Taos will incorporate an ambitious resource sharing module, which DRA calls WISRD for Worldwide Information Search, Retrieval and Delivery. WISRD will automate interlibrary loan, photocopy, and other document requests in one module compliant with ISO 10160/10161 standards.

The Taos Approach

DRA believes the benefits of its object-oriented client/server approach are distributed processing for improved performance and reliability, flexibility in configuring the system to match user needs, and the ability to change or enhance the system rapidly through the use of objects. DRA is the first vendor to announce the use of an object-oriented database management system (OODBMS). Although the benefits of an object-oriented database remain unproven in library systems, DRA's perspective is that the OODBMS is especially well-suited to handle the increasing amount of non-bibliographic material in libraries, since it can store materials in native form in the database. An object-oriented database may offer more flexibility in dealing with complex library materials such as multi-volume sets, periodicals with irregular publication dates, and image files.

TAOS TOOLS/FEATURES

Architecture
Taos uses a multi-tiered client/server architecture. Every Taos system has at least the following three tiers:

- User interface, which can be a thin client and support the use of networked computers;
- Application software, such as acquisitions and cataloging; and
- Database and dataserver.

DRA reports that Taos is designed to balance all potential combinations of network bandwidth and hardware processing power to maximize efficiency through object-oriented distributed processing. For communication between the client and the server, DRA utilizes Common Object Request Broker Architecture (CORBA) from the independent group, Object Management Group (OMG). [2] Supporting DRA's CORBA implementation is Orbix, the object request broker (ORB) from IONA Technologies, a company that creates standards-based, component architecture to support interoperability between distributed applications. [3] By using CORBA, DRA intends Taos to be fully cross-platform, cross-language, and cross-machine compatible.

The ORB used by Taos supports C++ objects and Java objects so that Taos can accommodate both PC-based workstations and Network Computers. A library will have the choice of using high end PC workstations with fully distributed client and server functions, or a large central server and network computers with thin-client software using Java. DRA anticipates most libraries will choose a combination of these approaches.

Database Management System
The initial object-oriented DBMS in Taos is ObjectStore produced by Object Design. [4] The OODBMS offers support for distributed processing and management of complex hierarchies such as are typically associated with library automation data. DRA contends that the OODBMS has significant design and performance advantages over a relational database management system (RDBMS), such as Oracle or Sybase, especially when object-oriented programming techniques are used. Object Design and IONA offer enterprise-wide Windows NT solutions, giving DRA a set of tools already available for use in an NT environment.

Like the ORB used by Taos, the OODBMS used in Taos supports C++ objects and Java objects. By using an off-the-shelf product for its OODBMS, DRA believes it will be able to accelerate development efforts, and provide "plug-and-play" simplicity for Taos, without reducing quality.

Search Engine
DRA's proprietary search engine makes use of full Boolean searching (including AND, OR, NOT, and adjacency/proximity strategies) and forward/backward browsing. Lists may be sorted by author, title, chronology, and reverse chronology. There are no mandatory stop words by server.

Network
DRA has considerable depth of experience in the network environment. The company maintains a

proprietary ATM backbone. Network consulting and installation services are available to assist libraries in making choices about network technologies and implementation.

Taos Computing Environment

Architecture	Multi-Tier Client/Server
Operating System:	
Client	Windows NT, CGI-compliant Web browsers
Server	Windows NT, Microsoft SQL server; UNIX: Digital, Sun Solaris, additional UNIX planned
Database Management System	OODBMS: ObjectStore
Search Engine	DRA Proprietary
Hardware:	
Client	For staff workstations (e.g. Technical Services client), Pentium processor, 32 to 48MB RAM, NIC; for OPAC, PC or NC capable of running a CGI-compliant Web browser.
Server	32MB overhead plus 1.5 MB per user

Standards

DRA has a long history of supporting the development and implementation of standards. DRA served as a co-founder of the Z39.50 Implementers Group and Interoperability Testbed. The company is a member of the NAILLD Interlibrary Loan Protocol Implementors Group (IPIG), NISO, and W3C, the World Wide Web Consortium.

DRA stresses that Taos is standards-based and supports Unicode, MARC, including the MARC format for holdings data, Z39.50 between level 2 and 3, CORBA, and EDIFACT and ASC X12, using a third party product.

Security

DRA provides a secure FTP site for software releases. Taos's CORBA support provides network transaction security via the Internet Inter-ORB Protocol (IIOP), part of the CORBA specifications. At the user level, access can be controlled down to the data element level.

Interface Design

Taos supports both Windows and Web clients. DRA's use of Unicode, combined with DRA Web2's ability to serve as an HTML-based OPAC implementation language, means that the user interfaces can

be customized individually, so the same library can offer different levels of searching complexity and different languages interchangeably on a single workstation. DRA reports that Taos can recognize a user login and present the user with his preferred interface.

Technical Support
DRA provides a toll-free service desk number which is staffed 24 hours a day, 365 days a year. All incoming calls are assigned a log number and are followed by a Web-based tracking system that monitors response time. Problems are escalated automatically if they are not resolved in a timely fashion. DRA assigns 30 staff to product support.

Training and Documentation
DRA works with customers to tailor training programs to the installation, according to software and hardware components in use. Class size is limited to allow for personalized coaching and hands-on practice. In addition to new site training, specialized expert training sessions are offered throughout the year in Monterey, Montreal, or St. Louis.

DRA provides users with online and printed documentation, updated regularly. PC-based products include detailed, searchable, context sensitive documentation/help systems built-in. Taos documentation and training are currently under development.

Planned Future Releases
DRA Classic has at least one major release per year. DRA anticipates that Taos releases will be more frequent, at least initially, and that modules will be updated individually. New releases of DRA Web2, for example, are currently sent out approximately every 90 days.

The initial installations of Taos effectively will be test sites, and the first release will most likely not be "frozen." DRA anticipates Taos will go live in summer 1998 with "Day 1" requirements.

ADAPTING TAOS TO LIBRARY NEEDS

Overall Adaptability
The central theme of TAOS's object-oriented design is flexibility and its ability to adapt to the individual characteristics of libraries, continuing DRA's tradition of policy-driven systems. The system is designed to be modular and scalable. It supports a wide variety of platforms, interface configurations, and distributed processing options. A "plug-and-play" configuration will be available for smaller libraries, and libraries desiring deeper access to the system will be provided Application Program Interfaces (APIs).

DRA supports an extensive range of library policy files. For libraries that wish to design or develop a unique application or implement time-consuming, onetime or ongoing changes to their systems, it is possible to hire specialists from DRA. As libraries begin implementing the Taos OPAC module, DRA has specialists on staff to assist in customizing the Web-based interface to the library catalog.

Support for Effective Workflows
Data Interfaces: According to DRA, the Taos cataloging module will have extensive multilingual

capability, along with ease of movement and numerous implementation options. Full Unicode support lets users enter and display all USMARC-supported character sets—such as Chinese, Japanese, Korean, Cyrillic and Hebrew—on workstations equipped with the appropriate fonts. In addition, DRA offers "on-the-fly" translation for Unicode that is not currently supported via USMARC and is working with several affected libraries and vendors in trying to establish better confluence between USMARC and Unicode.

Taos will continue the support now found in DRA Classic for downloading and processing of bibliographic data from bibliographic utilities such as OCLC, RLIN, and WLN, as well as from CD-ROM sources. Full authority control and maintenance is supported.

Local Processing: For those already accustomed to a Windows environment, the Taos cataloging module will incorporate standard Windows functions to allow the user to copy and paste into multiple records, edit multiple records simultaneously, move through separate functions quickly and easily, and take advantage of context-sensitive help and editing assistance features.

Migration/Transition: DRA has converted close to 100 libraries from other systems since 1986. Because the company has programs for converting from most major vendors, DRA asserts that the time and associated programming costs for conversion are significantly reduced. DRA reports that its evolutionary approach to Taos will allow current customers to begin realizing the benefits of distributed processing made possible by its object-oriented design. At the same time, they can protect the investments made in current capital equipment.

STRATEGY FOR NETWORKED INFORMATION

DRA was a pioneer on the networked information frontier. The company currently maintains a proprietary network backbone that serves several hundred libraries around the world. DRA was an early supporter of the Z39.50 protocols. Its Z39.50-compliant servers allow DRA libraries to permit access from other systems. Passwords or IP filters are used to restrict access to licensed databases. DRA's PC-based Z39.50 client DRA Find (and DRA Kids for children) allow users to search several databases (local or remote) simultaneously and merge the results. For example, searching and merging results from all the libraries in a region has the effect of creating a Virtual Union Catalog.

Support for Emerging Data Formats
Taos supports different types of MARC and non-MARC formats within a single database. This is a result of the object-oriented design.

The forthcoming Taos interlibrary loan module, WISRD, is DRA's answer to handling the burgeoning information resources available to libraries and users. With WISRD, DRA reports that the user does not need to worry about the format of the information or the source of it as the process for requesting materials—electronic, paper, local or remote—remains the same. The WISRD automates document delivery, intersystem delivery, photocopy services, statistics, tracking, and billing. It is compliant with ISO 10160 and 10161 protocols.

Taos Functions Availability

Function	Status	Availability
Acquisitions	Version 1	Q3 1998
Cataloging	Version 1 (now in beta)	Q3 1998
Circulation	Version 1 (now in beta)	Q3 1998
Electronic Reserves	—	—
Interlibrary Loan	Version 1 (in development)	Q4 1998
Media Booking	In design	1999
Serials	Version 1	1998
OPAC	DRA Web2	Now
Interface to CD-ROM Server	DRA Web2	Now
Z39.50 Gateway Search	DRA Web2	Now
Full-Text Retrieval	DRA Web2	Now
Full-Text Search	—	—
Graphical User Interface	Version 1 (all modules)	Q3 1998
Multimedia Retrieval		
Images	DRA Web2	Now
Audio	DRA Web2	Now
Video	DRA Web2	Now
Bibliographic Records Import/Export	Version 1	1998
Authority Control Import/Export	Version 1	1998
Standards Compliance		
Z39.2 (MARC)	Version 1	1998
Z39.50	DRA Web2	Now
EDIFACT	Future	Future
Unicode	Web2 Cataloging Other modules	Now Q2 1998 Q3 1998
Year 2000 Ready	Version 1	Now

Support for Electronic Payments
DRA plans to support credit card transactions and digital cash, and asserts that object-oriented design will allow the system to add objects to accommodate whatever type of electronic commerce emerges. DRA anticipates having licensable APIs so that third parties can write payment programs to the Taos system.

PRODUCT DEVELOPMENT INFRASTRUCTURE

Product Development and Enhancement
DRA sets its development priorities by listening to what existing customers are telling them, observing the marketplace, and relying on their own vision.

The Taos product concept was born about four to five years ago. At that time, DRA had fulltime people doing pure R&D and looking at what was needed for the future. It was out of the R&D group that the first DRA Web catalog emerged. As they identified a need for graphical user interface workstations, they decided there was a need for object-oriented programming and an object-oriented database, in effect requiring a total system rewrite.

Once the decision was made to write an entirely new product, DRA had discussions with its user groups. Both sides recognized that the traditional way of dealing with product enhancements, which was to cumulate thousands of suggestions for improvement on the product and then vote on the most important in each category, would not work in developing from the ground up. The user groups picked a few people to represent the DRA user community and gave DRA veto rights over anything they came up with. They signed nondisclosure agreements and worked closely with DRA on the design and review of the new product. Later, other customers were brought in to validate the designs.

CEO, Michael Mellinger, has been heavily involved in the way the new product is being developed to make certain it preserves those things the company has learned over the last 22 years. DRA has a development staff of about 30 people working full time on Taos. Mellinger estimates that his company has spent in excess of $10 million on Taos research and development. In the library community, DRA is an early adopter of object-oriented computing. DRA opted to go with Microsoft DCOM, Netscape, and Sun technologies for interoperability over Z39.50, which DRA considers an aging technology standard.

Development Partnerships and Technology Licensing
DRA has development partnerships with the following:

- Microsoft (DRA is classified as a "Solution Provider")
- Sun Microsystems
- Digital Equipment
- Hewlett Packard
- IONA Technologies (for the Orbix object broker)
- Object Design, Inc. (for the object-oriented databases manager).

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

In 1993, DRA purchased INLEX, Inc., an automation company based in Monterey, California. The purchase included INLEX/3000 which DRA continues to support. DRA accepted 104 contracts transferred from sites using the INLEX/3000 system. One year later, in October 1994, DRA assumed support and enhancement for 300 libraries in the U.S., Canada, South America, and Europe, with the purchase of MultiLIS, a division of Sobeco Ernst & Young, Inc. DRA plans continued support for INLEX and MultiLIS as long as those systems remain financially viable.

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Sales, Distribution and Support
All DRA products are sold through the company's own regionally based direct sales representatives.

Company Executives
Michael J. Mellinger, Chairman of the Board, President, CEO, COO and Founder
Katharine W. Biggs, Vice President, CFO and Treasurer
Joseph M. Bonwich, Vice President
Stephen P. Newman, Director of Worldwide Sales
Thomas M. Rafferty, Vice President

FINANCIAL STATEMENT

	1996	1997	% Change
Revenue ($000's)	$38,582	$35,369	-8.3

Fiscal year ends: September 30

DRA experienced a drop in revenues in fiscal year 1997 compared to 1996, which DRA attributes in part to a slowing of new system sales as potential customers wait for Taos development. Earnings of $4.49 million were comparable to FY1996 earnings of $4.45 million, marking the company's eleventh consecutive year of record earnings.

RELATED REFERENCES AND URLs

1. For a detailed description and discussion of DRA legacy systems, see William Saffady, "Vendors of Integrated Library Systems for Minicomputers and Mainframes: An Industry Report, Part 2 [Data Research Associates]." *Library Technology Reports* 33, no. 3 (May/June 1997): 289-299.

2. For more information about CORBA, see Object Management Group's Web site at http://www.omg.org.

3. See Iona Technologies' Web site at http://www.iona.com.

4. See Object Design's Web site at http://www.odi.com.

Sources: Interviews with Michael Mellinger of DRA; DRA product literature and Taos product description; and DRA Web site.

Endeavor Information Systems, Inc.

SUMMARY

Endeavor's strategy centers on seamless access to networked information and the library as the hub of the campus network. Endeavor developed Voyager specifically for academic and research libraries and intends to concentrate on this target group. The company plans to grow rapidly by pursuing academic and research libraries that want to optimize use of the campus network and the Internet to provide gateway access to information resources. Endeavor considers Voyager's differentiation—its "smart design"—to be in its combination of current technologies: multi-tier client/server architecture, a relational database management system, its graphical design, and its search engine. Endeavor's challenges for the next year include: achieving the goal of continued rapid growth, while at the same time ensuring that it continues to meet commitments for installations and deliverables currently under development.

ENDEAVOR INFORMATION SYSTEMS, INC.

URL: http://www.endinfosys.com

Ownership

Endeavor is an employee-owned company. Endeavor's President, Jane Burke, and several other former NOTIS employees founded the company in 1994.

BUSINESS DIVISIONS/UNITS

Endeavor's sole focus is on developing and marketing the Voyager library management system and related information management products. Company headquarters are located in the Chicago suburb of Des Plaines, Illinois.

PRIMARY PRODUCTS AND SERVICES

Endeavor introduced the Voyager system in 1995 and today offers Voyager and additional modules to help network and manage information through the Voyager system. As a new system from a young company, Voyager was built from the ground up on the latest technologies for software and architecture design.

Voyager—A UNIX-based, integrated client/server library management system. The system provides a full range of functionality for public access, cataloging and authority control, and circulation, including course reserves. System administration and report writing modules are included.

Citation Server—Designed to provide access to citation, abstract, and full-text databases with links to local holdings through the Voyager OPAC.

ImageServer—A document management system that supports digital collections and the creation of digital content, including electronic reserves, with direct link to the Voyager OPAC.

PRIMARY MARKETS

Endeavor developed Voyager specifically for academic and research libraries and intends to remain focused on this target group. As of January 1998, Endeavor had 137 libraries with Voyager either in production or in the process of implementation. At the time of this report, another 12 were in contract negotiations. The majority of Voyager customers are academic libraries ranging from small colleges to members of the Association of Research Libraries (ARL). Endeavor has also enjoyed success in winning business with consortia and research-oriented institutions, notably museum libraries and U.S. defense, intelligence, and government agencies. Voyager systems in production are supporting libraries ranging in size from a few thousand to millions of titles, with the largest individual institution being the former NOTIS site, Northwestern University. Endeavor's customer list, with some links, is available on the company's Web site.

OVERALL STRATEGY

Endeavor's overall strategy is to grow rapidly by pursuing academic and research libraries that are interested in optimizing use of the campus network and the Internet to provide gateway access to all manner of information resources. Endeavor believes two types of libraries will be most interested in the Voyager solution: libraries that need to migrate from older systems to a client/server environment, and libraries that see the OPAC as a resource for building the library's campus presence.

Seamless access to networked information and the library as the center of the campus network are the focal points of Endeavor's strategy.

Seamless Access

The Endeavor perspective is that libraries are in an extremely important transition regarding access to electronic information. Voyager is intended to address the need for a library system that provides full functionality for traditional library operations. It also, in the words of Endeavor President, Jane Burke, "moves up the foodchain" as an information gateway. Voyager, and its associated image and document management modules, are designed to provide management of and access to all forms of information, through a single interface.

Library in Central Role

Endeavor's design is intended to make it easy for institutions to choose Voyager. Voyager supports platforms that are already popular on many campuses: client/server architecture, compliance with library and networking standards, and use of a relational database. Voyager addresses the need for integration into a campus information network by providing mechanisms for transferring data between the library system and campus administrative systems.

VOYAGER

In production since 1995, Voyager is now in its sixth major release since its introduction. Available modules include: Public Access, Cataloging and Authority Control, Acquisitions and Serials Control, Circulation and Course Reserve, Report Writer, and System Administration. Optional modules are Citation Server and ImageServer, with Media Scheduling and Interlibrary Loan under development for release in 1998.

The Voyager Approach
Key themes of the Voyager product strategy are integration of components and information resources and the use of new technologies.

Integration: The vision for Voyager is one of integration, both internally, in terms of interaction between functions and modules and externally, in providing access to networked information. Voyager modules are integrated from the user's point of view, although the applications exist as separate objects on the server. The Web OPAC interface gives users seamless access to resources in the library catalog, locally mounted and hosted databases, CD-ROM networks, digital library collections, and the Internet.

New Technologies: Endeavor considers Voyager's differentiation—its "smart design"—to be in Endeavor's choice of current technologies: multi-tier client/server architecture, the use of the Oracle relational database, its design from inception as a graphical system, and its search engine. Endeavor's marketing literature asserts that Voyager is the "only multi-tiered client/server system...the only complete native Windows system...the only system featuring relevance feedback," although competing vendors have announced or introduced systems using one or more of the same core technologies.

VOYAGER TOOLS/FEATURES [1]

Architecture
Voyager employs a multi-tier architecture in which the application logic is separated from the database layer, and there is clear separation between the client functions, the server functions, and the database functions. The client manages the user interface, including presentation of the data through a graphical user interface, managing search strings and search sets, manipulating data, and so forth. Voyager clients can be GUI or HTTP based. Voyager's WebVoyage server interface allows Web browsers to function as the OPAC user interface.

Application server layers separate the client from the database structure. Each application layer performs a specific function, and applications interact with each other as required.

Endeavor's use of the multi-tier approach aids scalability because the application and the database layers can be scaled independently for more cost-effective hardware implementation. To scale the system, libraries can add servers or divide applications across multiple servers located anywhere on the customer's network. For libraries with large databases and/or many users, Endeavor generally recommends spreading the Voyager implementation across multiple servers. For example, the OPAC application can be housed on one server, the database on another, and the staff applications on another

server. Voyager is currently supporting implementations of 5,000 to 5,000,000 records, and from 2 to over 1,000 simultaneous users.

Database Management System

Voyager uses the Oracle relational database management system (RDBMS). The application layer and the database layer both reside on the server, and the application logic is separated from the database, ensuring that changes can be made in one layer without affecting the other.

Oracle includes a Report Writer which produces circulation statistics and overdue/recall/book availables, and acquisition purchase orders and vouchers. In addition, third-party software or customized applications using Structured Query Language (SQL) can be used to access the database for producing other types of management reports.

Search Engine

A key aspect of the Endeavor strategy is providing users seamless access to information through Voyager as a gateway. Endeavor considers the Voyager search engine a particularly strong feature of the library system.

Each library defines which fields in the MARC record will be indexed, which will be available only to staff, and which the public can access. Libraries can choose from various levels of search and retrieval options to provide their users. **Keyword** searching is enhanced by relevance ranking capabilities, as well as truncation and proximity strategies. Users can search or browse library-defined fields in **Headings** searches. The **Builder** option uses standard Boolean operators to search fields in the bibliographic record. For more experienced searchers, **Command** search allows for complex queries.

Voyager's search engine supports natural language queries and uses various algorithms to present results with relevance ranking. Endeavor reports that Voyager's search engine is unique in the industry in being designed to work specifically with bibliographic records.

Network

The Voyager system operates on any TCP/IP network, ensuring compatibility with the Internet and other high-speed networks.

Standards

Voyager support bibliographic variants of MARC, including LCMARC, OCLC MARC, RLIN MARC, LIBRIS MARC (Sweden), and the Community information format. All of the MARC variants are mapped to Z39.2 (USMARC) for storage in the Voyager database. In support of interoperability, the system's public access client and server both are Z39.50-compliant. Voyager is Year 2000 compliant. As a member of the NAILDD Interlibrary Loan Protocol Implementors Group (IPIG), Endeavor is committed to providing real-time interchange of interlibrary loan information based on the ISO 10160/10161 protocol. [2]

Interface Design

Voyager's OPAC provides a single graphical interface for searching the library OPAC; bibliographic and full-text databases; images, video, and audio files; and Internet resources. Both Windows and

Voyager Computing Environment

Architecture	Multi-Tier Client/Server
Operating System:	
Client	Windows 95 or NT
Server	UNIX: IBM AIX, Sun Solaris, Intel NT
Database Management System	RDBMS: Oracle
Search Engine	Endeavor proprietary
Hardware:	
Client	Any Windows-capable workstation with a WinSock TCP/IP stack. Recommended: at least Pentium 166 MHz processor; 32 MB RAM; 2.1 GB hard drive
Server	IBM RS/6000, Sun SPARCserver or Ultra Server, Intel NT Server

Web-based public access clients are available. The Windows-based clients for the staff modules make extensive use of standard windowing capabilities.

Security

Through the System Administration module, libraries can define security profiles for staff. Security options are available at different levels of record update.

Technical Support

Endeavor staffs a help desk from 7 a.m. to 7 p.m. CST on weekdays and provides 24-hour backup pager support for emergencies.

Training and Documentation

Endeavor provides onsite training by professional librarians for libraries implementing Voyager. The company provides printed manuals and documentation for the system, along with searchable context-sensitive help for all modules including the Web OPAC.

Planned Future Releases

Throughout 1998, Endeavor plans to expand support for patrons initiating requests directly in Voyager. Two major initiatives will result in direct transmission of interlibrary loan request information between Voyager systems and other interlibrary loan management systems.

The Keystone Library Network, a Voyager customer, is a participant in the larger Pennsylvania resource-sharing initiative, SSHELCO. [3] The participating libraries have selected CPS Systems as

the provider of a shared Interlibrary Loan System. [4] Endeavor plans to develop a mechanism for real-time transfer of ILL information between Voyager databases and the CPS database. This transfer is expected to be operational in the Voyager system in early summer of 1998. Voyager patron requests to participating institutions will be sent in real time, and requests from participating institutions will be integrated into Voyager's request handling and tracking system.

Endeavor is also committed to providing real-time interchange of Interlibrary Loan information based on the ISO 10160/10161 protocol, for delivery late in 1998. Voyager patron requests to ILL systems that support the standard will be sent in real time. Voyager's request and tracking functions will be used to manage incoming information.

In another development, Endeavor anticipates release of its Media Scheduling module in first quarter 1998. At the time of this writing, the module is in beta testing.

Endeavor reports that it plans to support Unicode to increase Voyager's ability to support multiple languages and scripts. The company also indicates that it is working on porting Voyager to the Windows NT platform so that libraries can choose an NT/Oracle server option.

ADAPTING VOYAGER TO LIBRARY NEEDS

Overall Adaptability

Through the graphical System Administration module, libraries control local options, policies, and security in Voyager. The system uses a "building blocks" concept to manage sets of policies and security authorizations for each module and functional area of the system. Because it is an open system, Voyager supports access to any of its data through any standard SQL tool such as Microsoft Access.

For more extensive customization, rather than supplying Application Program Interfaces (APIs), Endeavor publishes specifications for delivery of information into Standard Interface Formats (SIFs), which is one step removed from an API. Endeavor reports that by using SIFs, institutions can move data in and out of the system to accommodate the need to integrate library data into other information systems, such as those used by campus administrative operations.

Support for Effective Workflows

Data Interfaces: Through its Windows-based cataloging workstation, Voyager allows direct or batch import of MARC bibliographic or authority records from any bibliographic utility or other source of USMARC formatted records.

In the Acquisitions and Serials Control module, Voyager allows bibliographic records to be imported or created as needed. Endeavor supports Electronic Data Interchange through implementation of EDIFACT transactions for library processes, including quotations, orders, order acknowledgment, claims, claims response, and invoicing for both serials and monographs. EDIFACT is fully integrated into Voyager for automatic processing of EDI transactions. Endeavor has tested and implemented EDIFACT transactions with Harrassowitz [5] and will import and export EDIFACT transactions to any vendor that uses EDIFACT.

Voyager Functions Availability

Function	Status	Availability
Acquisitions	Voyager	Now
Cataloging	Voyager	Now
Circulation	Voyager	Now
Electronic Reserves	Voyager/ ImageServer	Now
Interlibrary Loan	Under development	1998
Media Booking	In beta	Q1 1998
Serials	Voyager	Now
OPAC	Voyager	Now
Interface to CD-ROM Server	Voyager	Now
Z39.50 Gateway Search	Voyager	Now
Full-Text Retrieval	Voyager/Citation Server	Now
Full-Text Search	—	—
Graphical User Interface	Voyager	Now
Multimedia Retrieval		
Images	Voyager/ ImageServer	Now
Audio	Voyager	Now
Video	Voyager	Now
Bibliographic Records Import/Export	Voyager	Now
Authority Control Import/Export	Voyager	Now
Standards Compliance		
Z39.2 (MARC)	Voyager	Now
Z39.50 (Level 3—1995)	Voyager	Now
EDIFACT	Voyager	Now
Unicode	In design	Q4 1998
Year 2000 Ready	Voyager	Now

Local Processing: Voyager's Cataloging module utilizes standard Windows multi-tasking capabilities and graphical interface intended to simplify the cataloger's work. The design supports multiple windows to allow the operator to enter data or edit records easily. In the Acquisitions and Serials Control module, serials check-in is supported by automatic prediction of serials issues so that, upon receipt of an issue, the operator can click on an issue to accept it and then to validate its location.

Endeavor is also concentrating on building into Voyager a variety of patron-initiated functions. For example, patrons can request holds and interlibrary loans through the OPAC. Voyager supports the 3M Self-Check system so that patrons can charge out items for themselves.

Migration/Transition: In migrating a library from another system to Voyager, Endeavor imports into Voyager both bibliographic and authority records. Holdings and item records can be created at the time of import. Endeavor also migrates serials receipts, open orders, vendors, patron records, and active circulation transactions.

STRATEGY FOR NETWORKED INFORMATION

Endeavor's support for networking information is central to the company's vision of the library system playing a more strategic role in academic and research libraries. Voyager supports a variety of means to deliver information to the user from disparate sources. The Voyager system is Z39.50 compliant on both the client and server. Users can conduct parallel Z39.50 searches simultaneously across the Voyager catalog and the universe of Z39.50-compliant servers, receiving search results presented as one unified set without duplication. Voyager also supports Z39.50 links to holdings. For document requests, the citation can be automatically loaded into an interlibrary loan "Get Me" request form.

The optional Voyager Citation Server supports networked access to citation, abstract, and full-text databases with links to local holdings through the Voyager OPAC. Citation Server allows libraries to load databases locally and supports HTML access to remote databases on the Internet. With Citation Server, a user can search the Voyager OPAC, locally mounted databases, and any Z39.50 databases in parallel and receive results in a single search statement.

Support for Emerging Data Formats

Another optional module, ImageServer supports managing and accessing digital collections. Libraries can use ImageServer to create and organize digital collections and to manage electronic reserve materials. As with Citation Server, ImageServer can be fully integrated with Voyager so that users can search for digital images from the Voyager OPAC. ImageServer creates USMARC bibliographic records and automatic MARC 856 field links during the image creation process. ImageServer supports any digital resource, including photos, audio, and other media. The module uses several mechanisms to support copyright compliance: fair use counts for printing; counts for viewing, faxing, editing, and image manipulation; and security for different classes of users and documents.

In looking to the future, Endeavor is contemplating additional development to support "cultural heritage" products. The company has identified a trend, particularly in the U.K., that considers library, museum, and archival data as "cultural heritage." Endeavor anticipates creating integrated access to this material.

Support for Electronic Payments
For billing purposes, ImageServer creates a user audit trail and a document transaction log. The module is integrated with Voyager's patron file to support centralized management of charges.

PRODUCT DEVELOPMENT INFRASTRUCTURE

Product Development and Enhancement
Endeavor reports that a number of inputs feed into the creation of product development priorities. Endeavor's user group and current customers channel requests to the company on a regular basis. Endeavor representatives and management spend a significant amount of time in the field talking with customers. RFPs also provide a source of information about libraries' needs and trends.

For its development methodology, the company indicates that it uses a variety of multi-tasking, multi-tracking techniques to move product development forward quickly. To support parallel development of all aspects of a particular release, the programming, quality assurance, documentation, customer services, and technical support staff work closely together and in parallel from the beginning of a development cycle. The server code for Voyager is developed in C/C++, and client code is written in C++ and Microsoft Visual Basic, an object-based Windows development tool.

Endeavor considers itself an R&D driven company. Approximately one-third of the company's employees are dedicated to development, separate from customer service and technical support.

Product Development Partnerships and Technology Licensing
Endeavor licensed search engine and image management technology for ImageServer from IA Systems, a company specializing in imaging technologies and workflows. [6] Endeavor has developed the links from the engine into Voyager as well as ImageServer's searching capabilities and algorithms.

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

Endeavor has acquired no other companies.

CORPORATE ORGANIZATION AND OFFICES

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Sales, Distribution and Support
Endeavor maintains it own direct sales and account management force of seven representatives located throughout the United States. Support for all Endeavor products is provided from company offices in Des Plaines.

Company Executives
Jane Burke, President and Chief Executive Officer
Verne Coppi, Vice President of Development
Cindy Miller, Director of Product Management and Strategic Direction
Don Reilly, Director of Sales

FINANCIAL STATEMENT

The company reports that it realized $2 million in profit on $9 million in revenues in 1997. Fiscal year ends: September 30.

RELATED REFERENCES AND URLs

1. For a detailed description and discussion of Voyager system characteristics, see William Saffady, "Vendors of Integrated Library Systems for Minicomputers and Mainframes: An Industry Report, Part 2 [Endeavor Information Systems]." *Library Technology Reports* 33, no. 3 (May/June 1997): 301-309.

2. For more information about the North American Interlibrary Loan and Document Delivery (NAILDD) Project, see http://www.arl.org/access/naildd/naildd.shtml.

3. For further information on Keystone Library Network see http://www.sshechan.edu/sskln.htm.

4. See CPS Systems Web site at http://www.cps.com.au.

5. See Harrassowitz Web site at: http://www.harrassowitz.de.

6. See IA Systems Web site at http://www.iasystems.com/.

Sources: Interviews with Jane Burke, Verne Coppi, and Cindy Miller; Voyager technical and functional overviews; and Endeavor Web site.

EOS International

SUMMARY

Gateway access to information and state-of-the-art technology are strong themes at Electronic Online Systems (EOS) International. Historically focused on smaller libraries, EOS is one of the largest vendors in the worldwide library systems market, as measured by total installations. [1] The company expects to attract more academic and public libraries with the new Q Series, a scalable, client/server based system, which EOS presents as a "one-stop gateway to the world of information." The strategy is to place the library at the center of all information seeking by the user, with Q Series at the core. The EOS goal is to help libraries better leverage their collections and to support document management initiatives. In support of EOS's strategy, Q Series is an open, standards-based system. It provides advanced searching capabilities and a flexible data structure. Challenges faced by EOS for the coming year include completion of key deliverables scheduled for Q Series Release 2; successful migration of its large base of customers to the Q Series and the PC-based GLAS system; and fulfilling the promise of Q Series as the "one-stop gateway."

EOS INTERNATIONAL

URL: http://www.eosintl.com

Ownership

EOS International is the company resulting from the combining of Data Trek, Inc. and IME, Ltd., which Data Trek acquired in early 1996. EOS International is part of the Electronic Information and Technical Services Division of Dawson Holdings, PLC, a publicly-traded information services company with annual revenues of over one billion dollars. The Dawson organization includes several information service providers such as Dawson Europe, Dawson North America (which includes The Faxon Company and Faxon Canada), EOS International, and Information Quest.

BUSINESS DIVISIONS/UNITS

Within the Dawson structure, EOS International is responsible for developing library automation software. A sister company, Dawson Information Quest, Inc., is developing a Web-based product called Information Quest (IQ), which is designed to provide a central index and access to the contents of electronic journals. The relationship of EOS and IQ will be discussed later in this report.

PRIMARY PRODUCTS AND SERVICES

EOS International produces and supports five library management system product lines. The first product introduced by EOS since the joining of the Data Trek and IME companies is the Q Series, a client/server automation system that runs on UNIX and Windows NT platforms.

Three product lines that originated at Data Trek, Inc. are:

- the Manager Series, a MARC compatible, text-based product line for smaller libraries;
- the Professional Series, an integrated full MARC text-based system aimed at larger libraries; and
- the Graphical Library Automation System (GLAS), a Windows-based library automation system.

From IME Ltd. came the T Series (formerly known as The Information Navigator or TINLAW in the United States and TINLIB throughout the rest of the world), a text-based system designed to handle the complex needs of larger libraries.

The Manager, Professional, and T Series are character-based products and are no longer actively marketed. They are being updated and supported but at a much slower rate than EOS International's standard two releases per year. EOS marketing currently focuses on GLAS and the Q Series and on encouraging customers to migrate to one of these newer systems. Since GLAS is a PC-based product, it falls outside the scope of this study, which will focus on the new client/server based Q Series.

PRIMARY MARKETS

EOS International currently serves over 6,500 libraries of all types in 85 countries. EOS reports that approximately 60% of its worldwide customers are special libraries, 20% are public libraries, and 20% are academic and school libraries. In North America, about 75% of these are special libraries (corporate, government, medical, law, national), 15% are academic, 7% are public, and 3% are school libraries.

Historically, EOS has focused on small libraries, which represent the majority of EOS installations to date. With the introduction of the Q Series, which is scalable and designed to serve any size library, EOS now expects to attract a growing number of academic and public libraries. T Series customers, which number approximately 2,600, are encouraged to migrate to Q Series, while GLAS will be appropriate for small to medium libraries needing a PC-based system.

OVERALL STRATEGY

EOS International's overall strategy is to provide libraries a single point of access to all information resources. EOS intends to produce library management systems that will allow librarians to organize and provide access to bibliographic records and holdings, information available on the Internet, and the institution's internal documents and reports, through one consistent interface. Gateway access to information and state-of-the-art technology are strong themes at EOS International.

Information Gateway

A major component of the EOS strategy is to supply a "complete information solution" by leveraging the offerings of other Dawson companies. In addition to EOS library systems, the combined companies offer book and subscription services, electronic journals content, and document delivery over the Web. EOS envisions the Q Series as a gateway to this world of information.

State-of-the-Art Technology

EOS reports that it carefully watches industry trends to identify new technologies that might be beneficial to its customers. EOS claims its products are created to meet five tests its clients say are required of a successful library automation system: usability, reliability, easy maintenance, adherence to library standards, and affordability. [2] The company spends approximately 30-35% of its budget on research and development.

Q SERIES

For the North American library market, the EOS strategy is encompassed in the newly introduced Q Series. EOS presents the Q Series not only as a library management tool, but also as an information gateway. The Q Series employs scalable, client/server architecture designed to manage libraries with collections of any size. The system will be targeted at libraries that require gateway access to commercial information sources and management of internal document repositories.

Q Series Release 1 is now in general production. Available modules include Cataloging, OPAC, Web OPAC, Circulation, and System Set-Up modules. EOS reports that beta testing went smoothly, with few problems discovered.

The first priority for EOS is to provide the Q Series system to existing customers of other EOS library systems. EOS expects most Professional and T Series customers (over 2,600 in number) to move to Q Series due to its functional robustness and use of newer technologies. At the time of this report, EOS had a backlog of 20 customers in the process of installing Q Series. These customers ordered the Q Series software prior to the first release of the system.

The Q Series Approach

Key aspects of the EOS strategy for the Q Series include: open systems design, flexibility, and gateway access to both internal and external information sources.

Open Systems Design: Q Series is an open, standards-based system. The EOS perspective is that continued change in technology makes it logical for libraries to choose open systems that can readily incorporate future technologies. EOS reports that it is committed to developing software products that conform to standards, and that it does not develop proprietary technology.

Flexibility: The Q Series client/server architecture can serve small to large libraries by supporting server configurations appropriate to the size and activities of the individual library. The Q Series supports libraries in adapting the system to their needs through parameter changes that can be made without the need for programming expertise.

Single Point of Access to Information: EOS intends the Q Series to provide a "single point of access to a world of information" whether located in the library catalog, locally, or remote mounted external third-party databases, or Internet-based resources. EOS also wants to support libraries in managing and providing access to internal documents such as memos, technical reports, and news wire service feeds, with a single user-interface that links the user to all local and non-local data, regardless of the

source of information. EOS's goal is to provide seamless access to information, envisioning libraries as "the information hub" for their users.

Q SERIES TOOLS/FEATURES [3]

Architecture
The Q Series employs a three-tier client/server architecture that separates the application programs from the database. The layers include:

- the server layer (maintains the various databases and associated indexes);
- the application layer (processes all transactions); and
- the client presentation layer (formats all the information on the screen).

The application software may utilize the server (sometimes called a "Fat Server") or the client (sometimes called a "Fat Client"), depending upon the task and the amount of computer resources required to do the work. The system is modular in that the applications can be distributed across multiple servers.

To scale the system to a library's need, the number of clients can be increased and additional servers can be added or the size of the server increased. Since the Q Series is a new system and EOS is currently installing it in the first customer sites, EOS has not yet delivered on the assurance of scalability from "10,000 to 10,000,000 titles." Of the current backlog of new Q Series customers, the two largest libraries are a military library and an academic library, both with approximately 200,000 to 250,000 titles.

Search Engine
A key component of the EOS "information hub" strategy is to provide sophisticated search and retrieval tools. EOS asserts that the real strength of the Q Series comes from its searching capabilities. The EOS goal is to help the library better leverage the assets in the library collection or among the organization's internal documents, by revealing to the user more relevant resources than is possible using traditional keyword/Boolean based systems. The Q Series provides searching capabilities based on natural language and other query analysis technologies, in addition to standard Boolean search.

To achieve what EOS considers to be superior searching functionality, the Q Series employs the Excalibur RetrievalWare search engine, licensed from Excalibur Technologies. This search engine allows the searcher to enter natural language search requests, which enable keyword, concept (automatic synonym searching), pattern matching (retrieval of misspelled words and spelling variations), and query-by-example searches, as well as standard Boolean searching. Results are presented with relevance ranking.

RetrievalWare uses a combination of technologies to drive a hybrid search and retrieval engine that produces "unrivaled accuracy, speed, and scalability." [4] Embedded in RetrievalWare is a full semantic dictionary of more than 400,000 word meanings, 50,000 language idioms, and 1.6 million word associations. Based on this dictionary, it expands queries and yields results based on word meanings, related words, and concept analysis. Another RetrievalWare feature is that it recognizes patterns in digital code in order to "fuzzy" search damaged, misspelled, or poorly scanned data to improve the accuracy of results.

A number of online publishers employ the Excalibur search engine, including Infonautics in its Electric Library online service, as do some defense and government agencies, corporations, and universities, to support document management and knowledge retrieval. This same search engine allows users to link dynamically to commercial content and electronic publishers via Information Quest, supporting the vision of the Q Series OPAC as a one-stop information gateway for the end user.

Database Management System

With Q Series, data is stored in either the Oracle or Microsoft SQL Server relational database management system (RDBMS). The RDBMS and the Q Series application communicate via SQL protocol for querying and updating the database. The database accepts variable length single and multiple-occurring fields, and each field may be repeated an unlimited number of times. There is no maximum length for single or multiple occurring fields.

Q Series Computing Environment

Architecture	3-Tier Client/Server
Operating System:	
Client	Windows 95, or NT Workstation v3.51
Server	Windows NT v3.51 or UNIX (Sun Solaris)
Database Management System	RDBMS: Oracle 7.1 or higher; Microsoft SQL Server
Search Engine	Excalibur RetrievalWare
Hardware:	
Client	Pentium 90MH Processor 32MB of RAM 72MB of Disk Space (OPAC Workstation requires 50MB).
Server	Pentium 166MHz processor dedicated file server 256MB of RAM 384MB (higher for more than 100 active simultaneous users, or if collection size exceeds 250,000 items)

Network

The Q Series uses the standard TCP/IP Internet communication protocol to move data between the client and the server. Each Q Series client is connected to the server in a stateless mode. The appropriate Application Program Interface (API) is sent by and/or received by the client to continue the user's session, task or activity. EOS indicates that this minimizes network traffic, and the power of the desktop computer is utilized as much as possible.

Standards

Among the standards that have been incorporated into Q Series are Z39.2 (the USMARC, UNIMARC and international variations), Z39.50 (to allow the interconnection of disparate systems for information retrieval), and the TCP/IP communication protocol. Q Series is Year 2000 compliant. All dates are stored with four digits for the year, and the user can specify how dates display using the windows set-up option.

Security

Password protection and software protection is provided for certain areas within system modules so that access and the ability to edit records can be limited. For each staff member, the library can determine what modules or portions of modules they can access and what functions they can perform within each module.

Interface Design

The Q Series clients provide a graphical interface to the system, using Windows 95 or Windows NT Client. Standard Windows functionality is supported, including point-and-click, menus and drop-down menus, popup/response windows, drop down and standard list boxes, multiple open windows, records, modules, and cut/copy/paste functionality.

Technical Support

Customers can contact EOS via e-mail, the Internet, or by toll-free telephone number. EOS provides customers three levels of support. The standard support option provides coverage from 8:00 a.m. EST to 6:00 p.m. PST. Extended hours and 24-hour coverage are also available at the customer's option. Extended hours coverage adds another four hours on Monday through Friday, plus Saturday coverage. The 24-hour support option provides support all day, seven days a week. Support for Europe, Africa, and Asian countries is provided from EOS local offices in those areas as well as by e-mail and the Internet.

Training and Documentation

EOS provides training at its Carlsbad offices on initial system set-up parameters, with on-site training provided to all customers upon installation. The company is also exploring the use of a new Internet-based product that would allow EOS to provide training for each module on a 24-hour per day, on-demand basis. Documentation is provided in both printed and online form. Online help is available using the Windows help facility.

Planned Future Releases

EOS plans two releases per year for Q Series. In 1998, EOS plans to support Z39.50 gateway searching of other Z39.50 compliant catalogs and databases, and retrieval and playback of audio files. Also in 1998, EOS plans to add Acquisitions and Serials modules in Q Series Release 2. EDIFACT for electronic data interchange of acquisitions and serials data will be supported when Serials and Acquisitions are released.

EOS reports that it plans support for the Unicode standard (Version 2) to allow cataloging and retrieval of information in multiple languages and scripts, by early 1999. In future releases, EOS is exploring the following additions: interlibrary loan and materials booking modules; searching of non-

text information, such as mathematical formulas or chemical structures; retrieval and playback of video files; and support for Java and possibly thin clients for the OPAC. Other RDBMS systems, Ingres for example, may become available in future releases.

Once it has completed a full release of the Q Series with all modules, projected for1999, EOS plans to investigate the state of technology and the potential for using network computers. EOS reports that the marketplace, particularly special libraries, is still very much focused on client/server technology using fat clients with Windows 95 on the desktop. With network computing still evolving, major issues for the network computer are the availability of software to support the network computer and the likely requirement for much higher LAN bandwidth.

ADAPTING Q SERIES TO LIBRARY NEEDS

Overall Adaptability

System administration is handled through the Set-Up Module within Q Series. The Q Series software is parameter driven, which allows a library to establish policies, to turn features of the software on and off, and to establish or change index fields as appropriate for the library's needs. When desired by a customer, EOS can make APIs into the system available so that the library can update selected portions of the database, such as updates to the patron database from the Registrar's Office.

Any customization of Q Series software requested by a customer becomes a standard part of the software available to any other customer and controlled by specific parameters. EOS believes that because it needs to support only one version of the software, the company provides a higher quality of support for all customers.

To support system administration efficiency, the Q Series server automatically downloads new client software when it detects that a client has not logged on to receive a new software release.

Support for Effective Workflows

Data Interfaces: The Q Series supports import and export of full USMARC bibliographic and authority records and can receive bibliographic data directly from an OCLC or BiblioFile workstation. In addition, EOS can convert most MARC or non-MARC databases into the proper format for Q Series.

As noted earlier, Serials and Acquisitions modules are not yet available in general release. The Acquisitions module will support import of bibliographic records for titles to be ordered and for approval plan materials. EOS plans to support all EDIFACT transaction sets defined by NISO/BISAC and NISO/SISAC. For example, Acquisitions will support orders, order acknowledgment, status update, and invoicing. The Serials module will support transactions for vendor correspondence including subscription purchase orders, purchase order acknowledgments, invoices, claims, and claims acknowledgment. At the time of this report, no decision had been made whether Q Series will employ third-party software to support EDIFACT transactions.

Q Series Functions Availability

Function	Status	Availability
Acquisitions	Release 2	September 1998
Cataloging	Release 1	Now
Circulation	Release 1	Now
Electronic Reserves	Future Release	1999
Interlibrary Loan	Future Release	1999
Media Booking	Future Release	1999
Serials	Release 2	July 1998
OPAC	Release 1	Now
Interface to CD-ROM Server	Release 1	Now
Z39.50 Gateway Search	Future Release	July 1998
Full-Text Retrieval	Release 1	Now
Full-Text Search	Intra Q Module	Now
Graphical User Interface	Release 1	Now
Multimedia Retrieval		
Images	Release 1	Now
Audio	Future Release	July 1998
Video	Future Release	1999
Bibliographic Records Import/Export	Release 1	Now
Authority Control Import/Export	Release 1	Now
Standards Compliance		
Z39.2 (MARC)	Release 1	Now
Z39.50 (Version 3)	Release 1	Now
EDIFACT	Release 2	1998
Unicode (Version 2)	Future Release	1999
Year 2000 Ready	Release 1	Now

Local Processing: In general, due to its use of standard Windows tools, the Q Series software does not require that a person finish a particular task or activity before moving on to another. Rather, the individual can use the system as best fits the nature of the task. To support cataloging, multiple windows can be open simultaneously for data entry or record editing, to access tools such as the LC Cataloger's Desktop or to download records from a bibliographic utility.

Migration/Transition: EOS highly recommends that it configure and load initial data on the server for the installing library, using the company's MARC loader program. Libraries may also input or load MARC bibliographic records on their own. In helping a library migrate to Q Series from another system, EOS creates a data map for migration of transaction data elements to the new system and preserves as much data as possible in the transition. EOS also provides support for loading of patron data files.

STRATEGY FOR NETWORKED INFORMATION

EOS International's strategy for supporting networked information is ambitious and comprehensive, although not all components are yet in place. The goal is to place the library at the center of all information seeking by the user, with Q Series at the core of a "one-stop gateway to the world of information."

With Q Series, the library can access both remote and local, MARC and non-MARC, databases. Patrons can connect directly to the Internet from an OPAC station or to a local CD-ROM network. In addition, patrons can access Information Quest through a special link between the Q Series and IQ to access tables of contents, abstracts, and the full-text content of electronic journals regardless of their location. As reported earlier, Z39.50 gateway searching is not yet available, but is planned for 1998 release.

Support for Emerging Data Formats

Q Series supports mixed data formats, and its flexible data structure is well suited to supporting digital libraries. Images can be linked to bibliographic records and displayed (in future releases, audio and video files will be listened to or watched) directly from an OPAC workstation by a patron at any location. The library can catalog Internet resources using the MARC 856 field to store the URL address. With the record displayed in the OPAC, the patron can double-click on the URL to make the Internet connection and display the information resource, for example, a photograph or an internal document located on the client's network.

To support the growing number of knowledge management initiatives, particularly in special libraries, the Q Series offers an optional module, called Intra Q, that allows the library to catalog documents such as technical reports or legal briefs, and to index every word of their contents using the Excalibur RetrievalWare search engine within the Q Series. Intra Q is intended as a solution for organizations that need a system to manage internally generated documents or other materials for which MARC cataloging records may not be available. These could include materials such as technical reports, mission-specific patent information, engineering drawings, clippings, and case files. Materials to be included in Intra Q must be available in electronic form in a compatible format such as flat ASCII, HTML, or as a scanned image with minimal citation information in machine-readable form.

Support for Electronic Payments
EOS reports that it has future plans to support electronic payments for Internet commerce through further enhancement to the Q Series. The company intends both to sell and deliver information products on the Web, presumably through the various Dawson companies, and to support a variety of payment methods for Internet delivery, including invoices, purchase orders, credit cards, and digital cash. EOS indicates it will integrate payment systems into the Q Series to support libraries and publishers in charging for information through subscriptions and individual transactions (such as pay-per-article).

PRODUCT DEVELOPMENT INFRASTRUCTURE

Product Development and Enhancement
EOS uses the rapid application development tool, PowerBuilder, to create the client software by generating object-oriented computer code. Other tools are used to track the location of data elements in the various files and to develop the APIs between the client and the server. Programmers and analysts provide quality assurance for the product before it is released and support the product after release.

EOS reports that customers assist in assigning priorities to enhancement requests. EOS logs enhancement requests received from existing customers, the sales team, and from requests for proposals. The enhancements list is periodically ranked by EOS customers to determine prioritization of features for future releases. During 1998, EOS plans to form a Customer Advisory Board to seek their input regarding the long-term direction of EOS products.

Development Partnerships and Technology Licensing
To date, EOS has not entered into any development partnership with a library or with another technology company. To support its strategy, EOS has licensed third-party products intended to ensure that the Q Series employs open systems design and state-of-the-art technologies. As mentioned earlier, the Q Series features the information retrieval capabilities of the Excalibur RetrievalWare search engine licensed from Excalibur Technologies.

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

Upon acquisition by Dawson Holdings, EOS International joined a diverse group of companies in North America and Europe. The range of products and services from Dawson companies include library management systems, optical imaging for document and information management, serials subscription services, and distribution of specialty books and CD-ROMs. The Dawson strategy leading to the EOS acquisition was to create an alliance of companies that gives libraries comprehensive information acquisition and management services.

CORPORATE ORGANIZATION AND OFFICES

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Sales, Distribution and Support
EOS International's sales are handled by a geographically aligned sales organization that works in close cooperation with distributors and partners. The EOS sales force includes field sales representatives teamed with inside customer account executives. In addition, EOS International supports 40 other offices and affiliates worldwide. Indirect channels used by EOS include authorized distributors and OEM integrators. Products sold through third-party sales channels are GLAS, Q Series and T Series (TINLIB overseas). EOS operates a two-tier distribution strategy, i.e., direct and indirect, because it allows the library to receive local support for both hardware and software.

Company Executives
Scot Cheatham, Chief Executive Officer, EOS International
David Cheatham, President, EOS International
Mark Patterson, Executive Vice President of International Operations
Joe Matthews, Vice President of Sales
Jeff Smith, Director of Development

FINANCIAL STATEMENT

	1996	1997	% Change
Revenue	$5,055,000	$4,825,000	-4.5%

Fiscal year ends: September 30 (Dawson Holdings PLC)

RELATED REFERENCES AND URLs

1. William Saffady, "Vendors of Integrated Library Systems for Minicomputers and Mainframes: An Industry Report, Part 2, [EOS International]" *Library Technology Reports* 33, no. 3 (May/June 1997): 320.

2. *About EOS International*, [Web site] 27 May 1997; available from http://www.eosintl.com/htdocs/datatrek.html; Internet; accessed 22 December 1997.

3. For a detailed description and discussion of Q Series system characteristics, see Saffady, "Vendors of Integrated Library Systems... [EOS International]," 311-322.

4. More information on Excalibur RetrievalWare is available on Excalibur Technologies' Web site at http://www.excalib.com/products/rw/rw.html. For recent background on the changing market for text retrieval firms, including Excalibur, see Paul Blake, "The Knowledge Management Expansion: Changing Market Demands Force Traditional Firms to Reinvent Themselves." *Information Today*, January 1998, 12-13, 18.

Sources: Interviews with EOS International Vice President of Sales, Joe Matthews; EOS product literature; and EOS International Web site.

Ex Libris Ltd.

SUMMARY

Flexibility and partnerships are strong themes at Ex Libris. As an international vendor with library customers in 32 countries, Ex Libris has proven its expertise in developing library systems that are adaptable to the needs and languages of different types and sizes of libraries in Israel and throughout Europe. With its client/server based ALEPH500, Ex Libris aspires to gain entry to the academic market in the United States. Key aspects of the Ex Libris strategy for ALEPH500 include: open systems design, flexibility to meet the needs of different types and sizes of libraries, and multilingual, multiscript language support. ALEPH500 makes extensive use of parameter tables which allows libraries to tailor the system. Ex Libris' strategy for supporting networked information is to provide a functional core library system, with a variety of links and interfaces to other systems or data sources. Ex Libris' challenges for the next year include: securing major library accounts to establish the company's presence in the highly competitive U.S. market, creating infrastructure to support market entry, and successful migration of ALEPH300 customers to ALEPH500.

EX LIBRIS LTD.

URL: http://www.aleph.co.il

Ownership

Ex Libris Ltd., a private company based in Israel, is owned by a small group of private individuals (roughly 50% ownership) and the Hebrew University of Jerusalem.

BUSINESS DIVISIONS/UNITS

The sole focus of Ex Libris Ltd. is on the development of the ALEPH Library Management System and marketing it worldwide. In addition to its corporate headquarters and development center in Israel, Ex Libris maintains sales and support offices in the United States, Brazil, Argentina, Luxembourg, and Germany.

PRIMARY PRODUCTS AND SERVICES

The ALEPH integrated library system was originally developed at the Hebrew University of Jerusalem in the early 1980s. During the next decade, ALEPH was redesigned and moved from the original Control Data Central mainframe to a VAX/VMS platform, then was ported to a UNIX platform in its third generation (ALEPH300). The fourth generation, ALEPH500, was introduced in 1996 on a UNIX-based, client/server architecture with graphical user interfaces.

Most of Ex Libris' customers currently have ALEPH300 which Ex Libris will continue to enhance, but at a slower pace. ALEPH500 is now the focus of Ex Libris marketing, and a migration path from ALEPH300 to ALEPH500 is available.

PRIMARY MARKETS

When Ex Libris enters a new market, it targets large academic libraries. Over 50% of Ex Libris customers are universities and colleges. The balance is a diverse mix of library types and sizes: national libraries, public libraries and special libraries, including government, museum and theological libraries, specialized research centers, and corporate libraries.

Ex Libris reported that at the end of 1997 it had installed or signed agreements with 380 library systems in 32 countries. Since many Ex Libris sites are library networks or consortia, the company reports that the actual number of libraries and licensed users served by its systems is considerably higher than the number of processor installations alone would indicate.

Ex Libris Customer Base

End of year:	1995	1996	1997 (est.)
Number of countries	26	29	32
Number of accounts	179	227	250
Number of libraries	228	314	380
Number of licensed users	5,720	7,316	12,000

Around 70% of Ex Libris customers are in Europe and 20% are in Israel. [1] Ex Libris currently has five library customers in the United States and a number of installations in Mexico, Brazil, and Argentina. The company landed its first major academic research library in the United States when it signed the University of Notre Dame libraries in February 1998. All Ex Libris customers are listed on the company's Web site with hotlinks to libraries' Web sites.

OVERALL STRATEGY

Ex Libris' overall strategy is to enter new geographic markets, using its experience in developing library systems adaptable for the varying needs of libraries in many countries and its expertise in supporting multiple languages and scripts.

The company's goals are to expand its worldwide market presence, particularly in the United States, and to achieve continued financial success by supplying a highly dependable library management

system. Ex Libris indicates that success in meeting its goals depends on having excellent technology people and a close relationship with and strong commitment to its customers.

Flexibility and partnerships are strong themes at Ex Libris. To support its global strategy, Ex Libris plans to:

- continue targeting larger, more demanding libraries;
- continue implementing standards as they become available and stable;
- implement an increasing number of electronic data exchanges and interfaces;
- provide flexibility and enhancement of core library automation aspects of the ALEPH system;
- continue to develop and incorporate links and APIs to other systems that may be important to libraries but outside the scope of ALEPH; and
- enter strategic partnerships where necessary to accomplish its goals.

ALEPH500

The Ex Libris strategy is reflected in the fourth generation ALEPH500, which Ex Libris presents as a "new model of an integrated library system." ALEPH500 is based on a multi-tier client/server architecture running on a UNIX platform.

Modules within the system include OPAC, Cataloging, Acquisitions, Circulation, Serials Control, Report Generation, and Interlibrary Loan. All modules (with the exception of the database for external interlibrary loans) share a common database.

The ALEPH500 Approach

Key aspects of the Ex Libris strategy for ALEPH500 include: open systems design, flexibility to meet the needs of different types and sizes of libraries, and multilingual, multiscript language support.

Open Systems Design: ALEPH500 is an open, standards-based system. Ex Libris' intent is to provide a system that will easily support changes in the database, clients, or application functionality without affecting other system components. The design goal is for ALEPH500 to have an effective ten-year life based on the ability to adapt new technologies into the current design.

Flexibility: ALEPH500 was designed with the underlying philosophy of maximum flexibility. The goal is to enable librarians to change processes and procedures to suit the library's needs, independently. ALEPH500 uses sets of parameter tables through which the system can be tailored according to individual library requirements, without the need for Ex Libris programming support.

Multilingual: The ALEPH system supports multiple languages and scripts, and is bi-directional, supporting both left-to-right and right-to-left alphabets. Users can access the system in different languages or scripts, and the ALEPH database allows for the use of a multilingual thesaurus and authority records.

ALEPH 500 TOOLS/FEATURES [2]

Architecture

ALEPH500 employs a multi-tier client/server architecture in which the system is split into logical segments with clearly defined interfaces to pass messages between them. The client is counted as one tier. The other layers are in the server or servers.

The client layer includes presentation services and logic. Clients can be an ALEPH GUI client, a Web browser, a terminal, or Z39.50 client. According to Ex Libris, cataloging is a relatively "fat" client; the OPAC is much thinner. Many libraries use Netscape or Explorer as the OPAC user interface.

On the server side, the layers include: data services and logic (the RDBMS, with I/O interface to the I/O engine), and application logic (ALEPH application services, or APIs, and various servers, such as the PC server, WWW server, terminal driver, Z39.50 server).

Ex Libris reports that it is possible to distribute the server power horizontally or vertically, splitting databases, applications, or layers to different servers, providing flexibility in accommodating different workflow and volume needs. To scale the system to a library's need, the number of clients can be increased and additional servers can be added or the size of the server increased. Ex Libris reports that it currently serves libraries with only a few workstations to large institutions with thousands of workstations.

Database Management System

ALEPH uses the Oracle relational database management system (RDBMS). The system is designed so that the database management system is a separate layer by itself architecturally with an interface layer between the database and the application code. This will enable Ex Libris to replace the Oracle database at a future time should another RDBMS become more desirable than Oracle, which currently enjoys great popularity in the marketplace.

ALEPH supports any Structured Query Language (SQL) querying of its database tables, for generating reports and statistics. In addition, through the database interface layer, ALEPH provides sets of predefined tools for retrieval, printing, and exporting selected data. Ex Libris reports that this database interface reconciles the relational database, which is constructed on fixed-length record with non-repeating fields, with the bibliographic database, which consists of unstructured, textual bibliographic information and indexes.

The company reports that ALEPH can support databases ranging between 100,000 to 9,000,000 records. Ex Libris recently completed performance testing a database of 6,000,000 records for Harvard University.

Search Engine

The ALEPH500 search engine was developed for the system by Ex Libris. ALEPH supports keyword searching using standard Boolean operators, with truncation and word proximity strategies available. The system also supports alphabetical browsing and direct access to records based on library-defined search parameters.

ALEPH500 Computing Environment

Architecture	Multi-Tier Client/Server
Operating System:	
Client	Windows 3.1, 95, or NT
Server	UNIX V: AIX 4.2, HP-UX, DEC UNIX 4.0b, Sun Solaris 2.5 (Windows NT under development.)
Database Management System	RDBMS: Oracle 7.3 or higher
Search Engine	Ex Libris proprietary
Hardware:	
Client	Pentium 16 MB of RAM preferred on the lead system
Server	IBM, DEC, Sun and HP servers supported 128MB RAM and 4 GB disk (for systems and work) Data: Each 100,000 bib records requires about 1 GB

Network

The ALEPH system works on any TCP/IP network. Communication is based on a stateless (self-contained) transaction model, with ALEPH's application servers maintaining continuous connections (with timeout) to the database, to ensure high performance.

The ALEPH software, coupled with TCP/IP, supports multiple library installations in local and remote nodes. Networking of multiple libraries in a virtual catalog is supported with one or more servers in a transparent mode. On a single computer, multiple libraries may share common data files or may maintain independent files. In either case, individual library policies are maintained. Each library in the network sets its own policies for bibliographic data, access files, screens, error messages, outputs, and circulation control. Each library can define how many external users can access the application at one time.

Networking in ALEPH relies on the copying and storing of certain parameter tables from the remote library to the local library. As a result, when accessing a remote library, data only is transferred on the communication lines. All utilities and procedures are operated locally.

ALEPH500 supports a Z39.50 server, utilizing Z39.50 (version 2—1992) protocol, enabling access to ALEPH catalogs via any Z39.50 client on the Internet. ALEPH also supports a Z39.50 gateway, which supports connectivity to remote Z39.50-compliant servers. The gateway is available for both the GUI OPAC and Web clients.

Standards

Ex Libris has implemented numerous standards in ALEPH500. Among them, the system supports Z39.2 (USMARC as well as UNIMARC and other national variants) and the Z39.50 and TCP/IP communication protocols. ALEPH500 is Year 2000 compliant.

Security

With the exception of the OPAC module, all modules of ALEPH are password protected. All functions that update data are password controlled. Passwords can be set for all ALEPH functions, or selected functions only, at the function and subfunction level. It is possible to set passwords with *read only* privileges.

Interface Design

Users can access ALEPH500 using graphical clients under Windows NT, Windows 95, WINDOWS 3.1, or using Web clients based on browsers such as Netscape and Explorer. ALEPH provides:

- GUI Clients for OPAC, Cataloging, Circulation, Acquisitions, Serials, Printing, and various administrative functions.
- WWW interface for OPAC, Batch Procedures, Tables Management, Authority Control, and Interactive Guide.

The user interface language can be in different languages, or in different scripts. In the GUI client, the user can change the language of conversation during a session.

Technical Support

Ex Libris reports that it supports its customers in 32 countries without having representatives stationed in all countries. The company uses dial-in capability to analyze a customer's system and make needed changes from Israel. Most communication takes place by e-mail, and most analysis and correction is done electronically.

To support its entry into the U.S. market, Ex Libris plans to establish a level of development and technical support in this country. A technical support person has been hired in the U.S., which will ensure greater self-sufficiency of the Ex Libris U.S. operation. Ex Libris indicates it will provide required hotline support as it develops its base of business in North America.

Training and Documentation

ALEPH training is conducted onsite, on the library's database and network. The ALEPH training program is designed for the different users of the system. For example, training for librarians includes analysis of the library structure and needs for the system, as well as an overview of the architecture and introduction to using parameter tables to modify the system locally. Training for systems managers examines the architecture more in depth and covers backup and recovery procedures.

User documentation takes the form of an Interactive Guide with a Web interface. This documentation includes special instructions to the systems librarian responsible for the configuration of tables and files. Also provided is printed documentation aimed at the systems librarian and systems manager regarding configuration and definition of tables, files, and formats.

ALEPH contains online help in all modules of the system, which can be called up by topic or keyword searching. Help files can be edited to suit the particular needs of an application. Context sensitive help is also available.

Planned Future Releases
Ex Libris reports that it is porting the system to Windows NT, which will make it possible for a remote library to have an independent server linked, but not totally dependent, on the network. Ex Libris is starting to explore incorporating Java technology into ALEPH. The company is also exploring integration of other relational database management systems with ALEPH. In the future, Ex Libris anticipates doing more work with interlibrary loan functions based on emerging ISO interlibrary loan standards. Future support for more languages is likely. As Unicode character support becomes available on the Web, Ex Libris plans to implement CJK character sets through Unicode.

ADAPTING ALEPH500 TO LIBRARY NEEDS

Overall Adaptability
ALEPH500 is based on extensive use of parameter tables which allow individual libraries to tailor the system by defining bibliographic, access, and index fields; display screens; messages; various character sets; command codes; and so forth. Libraries can change parameters for basic aspects like font and colors, and for more complex system administration tasks like security clearances and passwords.

Ex Libris does not provide source code, believing the advantage is that the company can maintain the code more effectively and economically. Through provision of parameter tables and APIs into the system, Ex Libris supports libraries in adapting the system locally, while maintaining "one system."

There is no limit to the number of fields that can be indexed in ALEPH, and libraries may add or delete indices at will. Processes and procedures can be modified independent of the developer. In addition, Ex Libris installs ALEPH with two copies of the system. One is a test copy so libraries can try all their changes on the system on the test database before implementing them in the production system.

Support for Effective Workflows
Data Interfaces: ALEPH500 allows for the import or export of bibliographic and authority data in MARC format from OCLC or RLIN. The system checks for duplicates when data is uploaded. These records can be retained in a review file. Parameter tables allow for conversion between different MARC standards (e.g., USMARC to UNIMARC). Authority headings may be used as a basis for creating headings in the cataloging database. The system allows for global corrections of headings in batch mode.

The ALEPH database environment allows for the use of a multilingual thesaurus. An authority database of multilingual records can be loaded into the system. The records in this database can have equivalent headings and references in any number of languages. The multilingual database may be consulted during the cataloging process, and headings copied into the cataloging record. In the OPAC, the user may search for any language equivalent of the heading as defined in the cataloging record. Up and down links may also be accessed in any language equivalent.

ALEPH500 Functions Availability

Function	Status	Availability
Acquisitions	ALEPH500	Now (GUI in beta)
Cataloging	ALEPH500	Now
Circulation	ALEPH500	Now
Electronic Reserves	—	—
Interlibrary Loan	ALEPH500	Now
Media Booking	—	—
Serials	ALEPH500	Now (GUI in beta)
OPAC	ALEPH500	Now
Interface to CD-ROM Server	ALEPH500	Now
Z39.50 Gateway Search	ALEPH500	Now
Full-Text Retrieval	—	—
Full-Text Search	—	—
Graphical User Interface	ALEPH500	Now
Multimedia Retrieval		
Images	ALEPH500	Now
Audio	ALEPH500	Now
Video	ALEPH500	Now
Bibliographic Records Import/Export	ALEPH500	Now
Authority Control Import/Export	ALEPH500	Now
Standards Compliance		
Z39.2 (MARC)	ALEPH500	Now
Z39.50 (1992—version 2)	ALEPH500	Now
EDIFACT	In development	1998
Unicode (Version 2)	In development	1998
Year 2000 Ready	ALEPH500	Now

Local Processing: The ALEPH system supports cataloging by providing flexibility of data entry and data manipulation options. New records can be added to the database by structured or ad hoc data entry, by copying or uploading information from an external file (e.g. tape or CD-ROM) or local client, or "pushing" a record through from the GUI OPAC to the Cataloging client. As ALEPH allows for the searching of any other ALEPH or Z39.50-compatible database, the user has the option of connecting to another database and copying bibliographic records found in these databases.

ALEPH is fully MARC compatible and also supports non-MARC codes. A library can opt to use a mixture of MARC codes for the cataloging of standard items, and non-MARC codes for the cataloging of special, nonstandard items.

ALEPH supports a 3M server, communicating to the 3M Self Check system via TCP/IP protocol. The ALEPH 3M server includes all checks and functionality available on the 3M station and is an integral part of the ALEPH system.

Migration/Transition: Bibliographic records, copies, issues, borrower records, circulation transactions, photocopy records, access files, and references between the access files, orders, and vendors can all be imported and exported to/from ALEPH. ALEPH has utilities for exporting ALEPH records to USMARC and UNIMARC in addition to standard external ASCII files.

STRATEGY FOR NETWORKED INFORMATION

Ex Libris' strategy for supporting networked information is to provide a flexible and functional core library system, with a variety of links, APIs, interfaces, and import/export functions to enable networking with other systems or data sources. ALEPH supports library networks and virtual union catalogs, which may function as a shared central database or as a central index of all libraries in a network. The link between the central catalog and local libraries is transparent to the user. ALEPH fully supports Z39.50 searching of ALEPH databases and via gateway to external Z39.50-compliant databases. As discussed later in this report, Ex Libris and SilverPlatter are developing a seamless interface between ALEPH OPAC and ERL databases.

Support for Emerging Data Formats

As mentioned earlier, a library can opt to use a mixture of MARC and non-MARC for cataloging a variety of materials. Interfaces to external images, text, and audio applications may be implemented as optional features to the standard ALEPH OPAC. The image, text, and audio management systems are not part of ALEPH and are usually composed of a combination of scanners, workstations, servers, storage media, and printers, with ALEPH APIs to support search and display functions. Images and text records can be displayed simultaneously with the relevant bibliographic information in separate windows, linked via the USMARC 856 field or its equivalent in the document record.

Support for Electronic Payments

ALEPH does not currently support electronic payments for delivery of information products on the Web, for either subscriptions or individual transactions (such as pay-per-article).

PRODUCT DEVELOPMENT INFRASTRUCTURE

Product Development and Enhancement
Ex Libris has development centers in Israel and Germany and plans to add development resources in the United States. As it enters a new market, Ex Libris dedicates development resources for that market. The company's perspective is that every country has unique requirements that a vendor has to meet to be a player in that market.

The company bases its development priorities on four inputs, each of which is considered separately, and each has a certain development resource allocation:

- ALEPH Users Group: The users group is active in maintaining and prioritizing requests for development purposes.
- Market trends, such as changes in standards and technologies.
- Recommendations from automation and technology consultants.
- Specific users, who sometimes fund a development for a particular need.

Development Partnerships and Technology Licensing
Ex Libris sees development partnerships as increasing in importance. Currently, Ex Libris, Ghent University Library (Belgium), and SilverPlatter are cooperating on a joint development project to integrate SilverPlatter's ERL databases with ALEPH library catalogs and holdings information. The objective of the project is to create a single interface between the ERL databases and the ALEPH OPAC, so that a patron searching the ERL databases could click on a button after finding an article, and seamlessly go into the ALEPH OPAC to check library holdings. The first phase of the ERL to ALEPH integration is already implemented at the Ghent University Library. A path from the OPAC into the ERL databases to view abstracts will be developed as a second project phase.

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

In 1997, Ex Libris acquired a German library automation company, DABIS GmbH, [3] and took the acquired company out of receivership. Ex Libris has an obligation to maintain the DABIS system for a period of time, but has announced at their users group meeting that the intention is to provide DABIS customers a migration path to ALEPH.

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Sales, Distribution and Support
Ex Libris sales are handled through company sales and support offices located in Israel, the United States, Brazil, Argentina, Luxembourg, and Germany. Each office is responsible for a geographic region and works cooperatively with distributors. Support is closely aligned with sales. Ex Libris has exclusive distributors that sell and support ALEPH in Denmark, France, Greece, Hungary, Italy, Mexico, Norway, Poland, Portugal, and South Africa.

Company Executives
Azriel S. Morag, Chairman
Ehud Arad, Managing Director
Rob Baum, Group Vice President, Emerging Markets
John Kolman, Vice President, Sales and Marketing, Ex Libris USA

FINANCIAL STATEMENT

Ex Libris reported that 1997 revenues were between $10 to $15 million and that revenues increased 27% from 1996 to 1997.

Fiscal Year Ends: December 31

RELATED REFERENCES AND URLs

1. Analysis of Ex Libris installed base derived from Ex Libris Web site.

2. For a detailed description and discussion of ALEPH system characteristics, see William Saffady, "Vendors of Integrated Library Systems for Minicomputers and Mainframes: An Industry Report, Part 1 [Ex Libris Ltd.]," *Library Technology Reports* 33, no. 2 (March/April 1997): 193-203.

3. DABIS Web site is located at http://www.exl.de dabis.

Sources: Interviews with Ex Libris Ltd. Chairman, Azriel Morag, and Group Vice President, Rob Baum; ALEPH500 specifications; and Ex Libris Web site.

Gaylord Information Systems (GIS)

SUMMARY

Integration of technologies and support for technology planning in libraries are the themes that permeate the strategy of Gaylord Information Systems (GIS). GIS describes itself as an organization in a market transition mode. Until recently a provider of library systems primarily to small and medium sized public libraries, GIS anticipates moving into the academic and larger public library market with its next generation system, Polaris. Polaris is completely Microsoft Windows based, including its operating system, its database management system, and its software clients. It is designed to integrate seamlessly with third-party software products. Gaylord considers its non-modular, or integrated, design of Polaris to be unique in the industry. Polaris supports an OPAC, patron services, cataloging, and acquisitions/serials control. Staff clients use a standard Windows interface, and even the Web OPAC is designed with a Windows "look and feel." Polaris has been designed to support optional unmediated user services and fee-collection mechanisms for services such as document delivery. One challenge ahead for GIS in the coming year is securing breakthrough accounts needed to move GIS toward its goal of being recognized as a major player among library systems vendors.

GAYLORD INFORMATION SYSTEMS

URL: http://www.gaylord.com

Ownership

Gaylord Information Systems is an operating unit of Gaylord Bros., which is a DBA and principle holding of the privately owned Croyden Corp.

BUSINESS DIVISIONS/UNITS

For over a century, Gaylord Brothers has been a provider of supplies and equipment exclusively to libraries—"everything but the books." Gaylord Information Systems is a division of Gaylord Brothers, and its primary business is library automation systems. GIS also provides retrospective conversion services, network products, network consulting, and a CD-ROM based subscription cataloging service called SuperCAT.

PRIMARY PRODUCTS AND SERVICES

GIS produces and supports two integrated library management systems:

GALAXY—Available since 1988, GALAXY is an integrated library management system marketed primarily to small and medium public libraries. [1] It is most effective as a system that supports up to

50 users. GIS has reaffirmed that it will continue to develop and support GALAXY concurrently with the new Polaris system.

Polaris—The Windows NT-based Polaris uses a distributed client/server architecture. GIS describes Polaris's design as non-modular, eliminating "walls between or across functions." There are four major groupings of subsystems: Online Public Access, Patron Services, Cataloging, and Acquisition/Serials Control. Intended for installations much larger in size and transaction volume than GALAXY, Polaris's first beta test site and customer was MCLINC, a Montgomery County, Pennsylvania, consortium, supporting nine servers and ultimately 300 workstations. Polaris will be the focus of this discussion.

PRIMARY MARKETS

GIS management describes GIS as an organization in a market transition mode. The GALAXY system has over 325 customers, all of which are in the United States. Approximately 85% are small to medium sized public libraries. The balance are special libraries, academic libraries, schools and others.

As it nears the end of its initial development phase, Polaris is intended not to replace GALAXY, but to expand the market for GIS library systems. The GALAXY product will continue to be marketed and supported in its planned market position. At the end of 1997 it was still GIS's dominant product.

Gaylord had traditionally positioned itself as a niche player in library automation, but with Polaris, GIS believes that position will change. GIS anticipates the market for its systems will expand in both size and breadth. The initial thrust will be into larger libraries. Gaylord expects to gain much more business in the academic library and K-12 markets.

GIS also plans to move into the international market. In anticipation of offering Polaris in Canada, Gaylord opened a Canadian sales office in 1996.

MCLINC became the Polaris beta test site in February 1997, concurrent with GIS's initial Polaris announcement. GIS is actively selling Polaris with the express intention of becoming one of the top three or four automation vendors in the industry. GIS claims that in recent RFP processes, Polaris has consistently been one of the final three or four systems considered. The company points to this as evidence that GIS has made the leap to being considered a major player. To date, GIS has seven contracts for Polaris, and two of the awards are for library consortia installations.

OVERALL STRATEGY

As libraries become more involved with the Internet, they are looking to vendors for help with a host of technology-related issues. GIS envisions itself as a technology provider for libraries, and this trend is influencing GIS' direction. Integration of technologies and helping libraries with technology planning are strong themes in GIS's strategy.

Integration of Technologies
GIS management asserts that libraries need to develop more technology awareness and a greater

ability to do technology planning. GIS sees its role as that of a systems integrator that adapts emerging technologies and third-party solutions to help make the business of libraries more efficient. GIS President, Mike Skiles, identifies this as an area where GIS is likely to provide more support in the future.

Technology Planning
Gaylord sees libraries as needing help in assessing differing technologies and with technology planning. GIS intends to help libraries focus on adopting appropriate technologies for the needs and requirements of the library.

POLARIS

To support its strategy, GIS designed Polaris from the ground up as a totally new system. Before undertaking Polaris development, GIS identified six basic features that it considered fundamental to a forward-looking system:

- Open, distributed client/server architecture,
- Multi-platform development,
- Non-modular approach to functionality,
- Wide-ranging adaptability of workflow design,
- Flexible interface capabilities, and
- Focus on access to electronic resources.

The Polaris Approach
In addition to being one of the first vendors to announce an NT-based system, GIS set out to differentiate itself in the library systems market through its use of Microsoft Windows standards, its adoption of third-party products, and the Polaris functional design.

Microsoft Windows: In designing Polaris, GIS chose complete adherence to the Microsoft Windows standard, which allows users familiar with other Microsoft products to transfer skills already acquired to the use of the library system.

Third-Party Products: GIS sees as a second differentiator the extent to which it has adopted third-party products. The Polaris report generator uses Crystal Reports. The thesaurus, spell checker and online dictionary are third-party products. GIS indicates that there will most likely be others in the future.

Functional Design: Another area of difference is in Polaris' functional design, which GIS says moves away from the traditional modular library systems structure. The product has two clients, a Web OPAC client and a Windows staff client. The staff client includes all of the technical services functionality and all of the patron services functionality. Polaris is a full functioning product "out of the box," and in Gaylord's view Polaris is truly integrated, without the separations that exist between modules in other library systems.

Major themes of the current design are increased unmediated services to patrons, the ability for the library to exercise its option to charge for particular services, and the system's openness to adaptation by the library.

POLARIS TOOLS/FEATURES

Architecture
Polaris is based on the Windows NT Server operating system and runs exclusively in that environment. Gaylord made its decision to go with NT because it is an open system that is scalable and not platform dependent. Polaris employs a three-tier client/server architecture, with the layers being the user interface, the applications, and the database. Each tier functions independently of the others and may be distributed across multiple system servers, to give each library optimal flexibility in system configuration.

GIS provided the following sample sizing information. For a small library (example: 100 workstations and 500,000 titles) with no requirement for a distributed configuration, GIS indicates that a typical hardware configuration might be Dual Pentium II, 300 MHz CPU, with 348MB memory, and 25-30 GB disk storage. For a large library (example: 1,200 workstations, 5,000,000 titles) with a geographically distributed configuration or a centrally located server farm, a typical configuration might be 4 Alpha 533 MHz CPU's, with 1.5 GB memory, and 80-100GB disk storage.

Polaris uses object-oriented design methodologies to break library applications into discrete functional capabilities. The programming language is C++. Together, these allow flexibility for reuse, transportability, and maintenance of code.

Database Management System
Polaris uses the Microsoft SQL Server relational database management system (RDBMS) and is compatible with other standard Open Database Connectivity (ODBC)-compliant database management systems, such as Oracle.

Search Engine
The proprietary Polaris search engine provides different modes of searching to support novice users, or children, versus expert users. It includes advanced searching features, such as relevancy ranking and user feedback. A "Search Wizard" can assist the user in creating complex searches, using Boolean logic, search limiting (date, format, language) and result sorting. A natural language searching facility is available as an option. GIS has licensed additional third-party tools to aid searching, such as an online dictionary, thesaurus, and spell checker.

Network
Polaris supports any TCP/IP networking environment. The type and speed of connection is dependent on the system configuration, including the distribution of the applications and databases. As a client/server system, Polaris passes only data down the lines, so there is less bandwidth required than traditional systems, except for Internet access and access to local non-text files.

1.0

Polaris Computing Environment

Architecture	Three-Tier Client/Server
Operating System:	
Client	OPAC client: Any operating system that can support a Web browser, i.e., Mac, Windows, UNIX. Staff client: Windows 95 or NT
Server	Windows NT Server
Database Management System	RDBMS: Microsoft SQL Server
Search Engine	Gaylord proprietary
Hardware:	
Client	OPAC client: Any workstation that can support a Web browser. Staff client: Minimum 486/66 PC; 16 MB RAM if using Windows 95. If using NT, 32 MB RAM; faster processor and more RAM recommended.
Server	Varies with size of library from small Intel single processors to multiple processors Alpha servers.

Standards

Among the standards that Polaris supports are Z39.2 (USMARC), Z39.50 (for both client and server), SICI, BISAC, and EDI ASC X12. Polaris is Year 2000 compliant, employing "Julian dating" in which a base date is chosen, and all subsequent computations are performed by counting the number of intervening dates.

Security

Gaylord works with customers and their Internet providers to establish firewall capabilities and workstation security.

Interface Design

The Polaris public access catalog works with any standard Internet browser and can run on Windows, MAC, and UNIX workstations. The OPAC user interface design takes full advantage of HTML and incorporates Active-X and Java applications. GIS makes extensive use of Active-X controls to create a single document interface for public access that looks and functions much like a Windows 95 interface. The single document approach ensures the user is always given a clear context for the search and is able to see headings, titles, and individual copy availability for a search without have to scroll or page within the Web interface. This approach also allows support for additional functions that enhance the public access software, such as a spell checker, an online thesaurus, and an online dictionary.

The staff client uses a standard Windows interface. Polaris makes extensive use of the right, or secondary, mouse button capabilities included in Windows. For example, a library staff member searching for a patron record by name can link directly from the list of hits to a patron status workform, then renew items or process financial transactions. Acquisitions staff can locate bibliographic records and paste them directly into purchase order workforms. This functionality enhances navigation between individual functions and subsystems.

Technical Support

GIS supports a Help Desk for technical support, used primarily to report problems or issues with the software, hardware or documentation. GIS also offers customers optional Technology Consulting and Auditing. With this service a senior Polaris staff member goes onsite on a regular basis to work with the library to insure that Polaris is being utilized to its maximum capacity. These sessions can be used to discuss the library's ongoing technology plans and to look at ways in which both Polaris and other technologies can be most effectively and efficiently used.

Training and Documentation

GIS provides training for all Polaris functions. The library is responsible for a reasonable level of familiarity with both the client operating system environment (Windows 95 or Windows NT Workstation) and the Windows NT Server operating system. GIS reports that since Polaris is designed using Windows standards, it is intuitive and requires little separate training. Much of the Polaris-specific training involves consultation with the library to determine the library's specific utilization of Polaris. Training is typically provided onsite. All Polaris documentation is provided online, for the system and help for individual functions and workforms. GIS also provides written documentation to customers relating to specific implementation and installation issues.

Planned Future Releases

Plans for Polaris Release 2 have not been finalized, but may include a media booking module, support for interlibrary loan, and homebound patron support. Gaylord is a member of the NAILLD Interlibrary Loan Protocol Implementor's Group (IPIG), which represented a commitment by the vendor to comply with International Standards Organization (ISO) interlibrary loan protocols. [2] As mentioned earlier, Gaylord also plans to continue to support and enhance GALAXY.

ADAPTING POLARIS TO LIBRARY NEEDS

Overall Adaptability

Polaris was explicitly designed with adaptability as its core goal. The "Polaris Management Summary" expresses the product design philosophy:

> "In developing Polaris, GIS rejected the traditional model of developing a product and then seeking a market; in its place, we instituted a cooperative partnership with a core group of libraries, so that the end product fits the precise needs of the library community. This unique approach has resulted in a library automation system that is more oriented to the actual

Polaris Functions Availability

Function	Status	Availability
Acquisitions	Release 1	Now
Cataloging	Release 1	Now
Circulation	Release 1	Now
Electronic Reserves	Future	Future
Interlibrary Loan	Future	Future
Media Booking	Future	Future
Serials	Release 1	Now
OPAC		
Interface to CD-ROM Server	Release 1	Now
Z39.50 Gateway Search	Release 1	Now
Full-Text Retrieval	Release 1	Now
Full-Text Search	—	—
Graphical User Interface	Release 1	Now
Multimedia Retrieval		
Images	Release 1	Now
Audio	Release 1	Now
Video	Release 1	Now
Bibliographic Records Import/Export	Release 1	Now
Authority Control Import/Export	Release 1	Now
Standards Compliance		
Z39.2 (MARC)	Release 1	Now
Z39.50	Release 1	Now
EDIFACT	Future	Future
Unicode	Release 1	Now
Year 2000 Ready	Release 1	Now

methods and processes of the library than was any other system before this time. More important, Polaris is flexible and adaptable, and easily changed to suit the work patterns of different library personnel — rather than impose a methodology of its own, Polaris allows users to mold the system to meet their own needs."

GIS indicates that Polaris' use of HTML and Windows technologies are aimed at "breaking down the traditional walls between subsystems/functions in library automation" to achieve a high level of flexibility and adaptability.

The library can modify the HTML OPAC interface to conform to the library environment, as all changes are parameter based. The Windows staff client uses standard set-up options.

Support for Effective Workflow

Data Interfaces: The Polaris acquisitions and serials control subsystems are designed to support exchange of information and transactions between the library and its vendors. Polaris supports BISAC, ASC X12, and other electronic links to a library's suppliers for financial transactions and electronic claiming. The Polaris accounting subsystem interfaces with all other subsystems and tracks accounting both for library materials expenditures and for patron accounting.

Polaris provides full support of the MARC format and records in other formats, including SGML and HTML. Also included is support for all major authority control schemes, including LC name and subject, MeSH, PRECIS, and support for multiple call number schemes. All diacritics and the full American Library Association (ALA) character set through Unicode are supported in Polaris. Polaris facilitates import of records from a variety of sources, including the major bibliographic utilities: OCLC and RLIN, and cataloging products like BiblioFile and SuperCAT.

Local Processing: GIS stresses that Polaris is designed to help streamline work by molding itself to the needs of the user. Supporting technologies include extensive use of right mouse-button functionality, links and tools, and standard workforms to allow users to focus on accomplishing a task rather than accommodating the system itself.

A variety of workforms are maintained for local editing of records in both MARC and non-MARC formats. Polaris allows online editing of bibliographic, item, and authority records from anywhere in the system by an authorized user. There is a seamless interface between cataloging and all other subsystems within Polaris, so that the user can immediately determine a title's ownership and status.

Another core Polaris goal is to increase libraries' ability to offer unmediated services to patrons. Through Polaris, the library can allow patrons to place holds, renew items, cancel holds, and query their own patron record as a part of the Web OPAC client. The patrons can also compile bibliographies; access the Internet; send and receive e-mail; place ILL, photocopy, or document delivery requests; and maintain current awareness/SDI profiles. If the library chooses, any of these can be fee-based services, tracked through the Polaris accounting function.

Migration/Transition: Polaris uses standard bibliographic import/export routines and all existing Microsoft tools. Gaylord has a conversions group that will work with new customers on bibliographic and transaction data conversions. GIS does not anticipate much migration from GALAXY to Polaris, at

least initially. Customer decisions to convert, and migration plans to support conversions, will be based on a "readiness audit" and cost considerations based on required capacity.

STRATEGY FOR NETWORKED INFORMATION

GIS's vision of the future encompasses making electronic resources available both within the library and to users in their homes and offices. GIS's President Mike Skiles believes libraries are the obvious information processor of our society. He points to Bill Gates's interest in the home market. In Skiles's vision, Microsoft and the telephone companies are going to be the technology suppliers to the home, but among the obvious content suppliers to the home should be libraries. He acknowledges there are copyright hurdles to cross, but that libraries must be thinking about making information packageable and available on demand. GIS points out that object-oriented technology allows efficient storage of mixed media—sound waves, digitized images, text based collections and so on. If stored in a common, network accessible database, these materials can be made broadly available.

Support for Emerging Data Formats
The Polaris system supports electronic links via the MARC 856 field, or other location in a record, to materials in the library's own collection and to resources available at remote locations. The Polaris public access client is Z39.50 compliant, as are the Polaris servers.

Support for Electronic Payments
In Gaylord's view, library systems will continue to be the central technology component of libraries, with extensions to Internet use through Web-centric OPACs, Z39.50 searching and the like. GIS plans to address built-in support in Polaris for optional charging schemes to support libraries in offering fee-based services.

PRODUCT DEVELOPMENT INFRASTRUCTURE

Product Development and Enhancement
Like most other automation vendors, GIS uses a variety of formal and informal methods to gather information needed to drive the product development and enhancement process. The company relies on sales presentations as an excellent informal method; customer feedback is another.

For an established product like GALAXY, most product direction comes from customer feedback. GIS uses a formalized feedback system and prioritization of enhancement requests from the customer base. According to GIS, this type of feedback tends to be incremental. Customers presume the current product and look for incremental functionality improvements.

With a new product like Polaris, GIS reports that the process is more marketplace responsive. The design team for Polaris, which included experienced librarians working side-by-side with software developers, worked for over two years. The team based its work on review of recent RFPs, on input from prominent consultants and librarians, and on studying the trade literature.

Gaylord used Rapid Application Development (RAD) tools in the creation of Polaris. The GIS perspective is that developing a product using a very strict and detailed object-oriented design allows for more time spent up front writing code, then moving quickly through prototyping and refining a prototype. With Polaris, GIS used repetitive prototyping, which allowed the company to test initial ideas and improve on them based on feedback from prospective customers. Gaylord estimates that, of a total staff of about 90, about 25 people are dedicated to both new and enhancement-based product development.

Development Partnerships and Technology Licensing
Gaylord is a certified Microsoft Solutions Provider. As noted, the Polaris system is almost totally Microsoft based. In addition, GIS takes a very open position toward working with third-party software suppliers. Examples are Crystal Reports, the supplier of the Polaris report generator, and the online spell checker, thesaurus, and dictionary which are licensed from INSO.

Polaris was built using object-oriented design methodologies and C++ programming language. GIS has broadly adopted Microsoft technologies, including Active-X, COM, and DCOM for manipulating objects. In addition to the technologies already employed in Polaris, GIS is exploring extensions to that system. Such extensions would allow enhanced support for image management, for fee-based services, and for services to users outside the library walls.

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

Gaylord Information Systems has acquired no other companies.

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Sales, Distribution and Support
To sell its products, GIS utilizes its own field-based direct sales staff, based in the United States and Canada.

Company Executives
Ron Beckman, President, Gaylord Brothers
Mike Skiles, President, Gaylord Information Systems
Chris Kirby, Director of Marketing
John Richardson, Director of Sales
Susan Stearns, Director of New Product Development

FINANCIAL STATEMENT

The company reports that annual revenues are in the range of $10-15 million.
Fiscal Year Ends: December 31

RELATED REFERENCES AND URLs

1. For a detailed description and discussion of GALAXY system characteristics, see William Saffady, "Vendors of Integrated Library Systems for Minicomputers and Mainframes: An Industry Report, Part 1 [Gaylord Information Systems]." *Library Technology Reports* 33, no. 2 (March/April 1997): 205-217.

2. For more information about the North American Interlibrary Loan and Document Delivery (NAILDD) Project, see http://www.arl.org/access/naildd/naildd.shtml.

Sources: Interviews with Mike Skiles and Susan Stearns, Polaris product literature, and Gaylord Information Systems Web site.

Information Dimensions Inc. (IDI)

SUMMARY

Scalability, speed of deployment, and leveraging existing investments are key themes at Information Dimensions, Inc. (IDI). With its TECHLIB library systems, IDI focuses on special libraries and corporate information centers in Global 2000 organizations, the world's largest corporations and governments. IDI is developing its third-generation library system, BASIS TECHLIB, which is based on client/server architecture, with a Web browser interface. BASIS TECHLIB is designed to provide patron access to library collections and digital documents, as well as to manage library cataloging, circulation, serials control, and acquisitions functions. The IDI strategy for TECHLIB is to provide traditional library management system functionality, integrated with access to external databases and internal document repositories. In support of IDI's strategy, BASIS TECHLIB is designed to manage diverse and very large document collections through its underlying BASIS extended relational database management system (RDBMS). The client side of the new system relies on open design and communications protocols. The integrated BASIS RDBMS and search engine have long been IDI's flagship products. IDI's challenges for the coming year include delivering key components of its new system that are still under development and testing; migrating its existing TECHLIB base to the new architecture; and attracting new library customers in a marketplace that is trending toward open rather than proprietary components.

INFORMATION DIMENSIONS INC. (IDI)

URL: http://www.InformationDimensions.com

Ownership

Information Dimensions was formed in 1986 as a wholly-owned subsidiary of the Battelle Memorial Institute. In 1993, Information Dimensions became a wholly-owned subsidiary of OCLC. In July 1997, Information Dimensions was acquired by Gores Technology Group, a worldwide high-technology business application software company comprising independently operated software companies. [1]

BUSINESS DIVISIONS/UNITS

IDI's sole focus is on the development and marketing of its BASIS product line, including the TECHLIB library system. In addition to its corporate headquarters in Dublin, Ohio, IDI maintains sales and customer support offices throughout the United States and Europe.

PRIMARY PRODUCTS AND SERVICES

The BASIS product line originated from full-text retrieval technology developed by Battelle to support its massive research and reference information requirements. The current generation product was released in 1990 and has evolved through eight major releases. The BASIS product line consists of:

BASIS Document Manager—IDI's flagship product, BASIS, is a database management system designed to provide control, management, retrieval, and navigation of very large document collections. Documents, their attributes, and their structure are stored in BASIS, an extended-relational database optimized specifically for document objects. Supported document types include SGML, HTML, tagged text, word-processing documents, and bibliographic records.

TECHLIB—Built on BASIS Document Manager, this integrated library management application was designed to run the daily operations of a corporate, government, legal, or special library. The original version of TECHLIB was built on BASIS with a conversational menu style interface. The second generation TECHLIBplus was introduced in 1990 and is the system IDI customers are currently using. TECHLIBplus uses a full screen, character-based interface. IDI is now developing the third generation library management system, BASIS TECHLIB, which is built on BASIS V8.2, with a completely browser-based interface. The "TECHLIBs" all use the complete BASIS functionality and have its full toolset available for customization. BASIS TECHLIB will be the focus of this report.

BASIS WEBserver Gateway—Provides Web access to BASIS document collections through standard Web servers and clients. Access to collections can be restricted to an organization's intranet or can extend to business partners, customers, or the general public.

BASIS Intranet Solution package incorporates a rapid prototyping tool, called the **Corporate Information Centre** (CIC), designed to allow companies to build document management applications using customizable, graphical Web-page interfaces and underlying templates.

PRIMARY MARKETS

IDI focuses on the Global 2000 organizations, the world's largest corporations and governments. IDI customers tend to be large, research-oriented institutions in publishing, manufacturing, government, legal, pharmaceuticals, petrochemicals, utilities, aerospace, financial services, and other industries. A particular emphasis is on organizations where security, litigation, or publishing is a primary concern, which drives the need for managing the knowledge housed in large document repositories. Examples of organizations using BASIS to manage their critical business documents include: 3M, Boeing Corporation, Shell, United Technologies, Musee d'Orsay, Saab Military, Axel-Springer, and the Taiwan Legislature.

IDI estimates that 30% of its business is with government entities and 70% with commercial enterprises. The company targets organizations that need a high-end solution for knowledge management. IDI does not envision the mix of its customer base changing. IDI reports that today its BASIS systems are installed worldwide in over 2,600 sites, serving the needs of more than one million users. The TECHLIB

library system is installed in about 250 corporate information centers and libraries, primarily in the United States and Europe.

OVERALL STRATEGY

Information Dimensions' overall strategy is to provide Global 2000 corporations and government organizations with software solutions that leverage documents, which IDI says are organizations' "most meaningful and under-utilized assets." Through its BASIS product family, IDI's intent is to allow organizations to increase their competitiveness by controlling and providing effective access to organizational knowledge. The Information Dimensions product strategy is to deliver BASIS solutions that "continuously push the industry to new levels of scalability and interoperability" as a means to increase the value of document collections. Scalability, speed of deployment, and leveraging existing investments are key themes at IDI.

Scalability

According to IDI, BASIS is highly scalable with regard to the size and complexity of the document collections, the number and types of users, and the range of applications that can be implemented within an enterprise. Specific benchmarking data was unavailable, but IDI reports that TECHLIB is used to manage libraries with 5,000 titles, and libraries with 800,000 titles serving more than 50,000 employees. Some of the largest databases in the world are managed with BASIS, including the Thailand Ministry of Interior database of the country's population. The database stores date of birth, ancestral history, photograph, and thumbprint for 60 million Thai citizens. Approximately 30 gigabytes of information is stored in this vast database.

Rapid Deployment

BASIS products include industry-standard tools designed to allow rapid customization of BASIS applications in a graphical environment. IDI asserts that the degree of customization possible with BASIS products is a major differentiator for IDI compared to other vendors.

Leveraging Existing Investments

At the core of IDI's strategy is the goal of helping organizations make their critical documents accessible across the organization and thereby leveraging the knowledge base of an organization. In addition, because BASIS products operate in mainstream computing environments, IDI helps leverage existing technical infrastructure investments. BASIS operates in UNIX, Windows NT, and VMS environments, across TCP/IP networks, using Web server and client software, and Structured Query Language (SQL)-based Open Database Connectivity (ODBC)-compliant application development tools.

BASIS TECHLIB

For special libraries and information centers, the IDI strategy is encompassed in the BASIS TECHLIB library system. The IDI objective is "to provide a state-of-the-art library automation product and continue the Information Dimensions custom of *leading special libraries into the future.*" IDI sees libraries as requiring an infrastructure to manage digital documents, Internet resources, and multimedia,

as well as traditional print materials. BASIS TECHLIB is designed as an integrated suite of programs that provide patron access to library collections and digital documents. It also manages library cataloging, circulation, serials control, and acquisitions functions. The BASIS TECHLIB suite replaces IDI's TECHLIB and TECHLIBplus.

The new BASIS TECHLIB is built on the latest version of BASIS products to support the information center's ability to manage and provide access to documents on an enterprise-wide basis. The new system is based on two- and three-tier client/server architecture and runs in NT and UNIX environments.

The BASIS TECHLIB Approach

Key aspects of the IDI strategy for TECHLIB include the integration of internal and external access to information and support for very large databases. TECHLIB is intended to provide traditional library management system functionality, combined with integration and access to external databases and internal document repositories. BASIS TECHLIB provides an open architecture and flexible interfaces to meet the rapidly changing requirements of the digital library, and to provide access to electronic documents regardless of format or location.

The transition from TECHLIBplus to BASIS TECHLIB affects only the user-interface portion of the system; the underlying database does not change. IDI reports that this development approach means that new customers may begin their implementation and data conversion and be positioned to utilize the new browser-based modules when they are complete. Similarly, existing customers will transition to the new interface without the need for data migration. The BASIS Techlib modules coexist with TECHLIBplus modules so that a complete solution, including cataloging, circulation, serials, and acquisitions is available.

Integrated Information Environment: IDI sees the need to move toward creating one common technical environment for traditional library applications and for managing a wide variety of document sources. The company believes the trend of librarians assuming the role of knowledge managers will continue, particularly among special libraries.

Support for Large Databases: BASIS, which supports TECHLIB, is designed for fast performance with large document collections. The BASIS database structure can support document collections of 100 gigabytes and more. Documents themselves can be extremely large (up to 128 MB). BASIS supports very large index files (2.1 to 4.3 gigabytes depending on operating system, with up to 63 files per database). Multiple servers can scale to support large user communities.

BASIS TECHLIB TOOLS/FEATURES [2]

Architecture

The older TECHLIBplus employs a two-tier client/server architecture on UNIX or VMS platforms. IDI is developing the next generation BASIS TECHLIB in a three-tier environment in which the first tier is a Web browser on a desktop; the desktop can be any type of workstation available today that can support a browser.

Tier two in the new implementation is a Windows NT server, which is where the application logic is housed. IDI has adopted Microsoft Active Server Pages for development. BASIS TECHLIB uses the Microsoft Active Platform to implement the business application of the library administrative functions (cataloging, circulation, serials, and acquisitions). The patron access component (OPAC) uses the BASIS WEBServer Gateway. WEBserver Gateway features an API level integration with either Netscape or Microsoft Webservers. This implementation lets libraries manage the WEBserver directly on the machine that hosts the BASIS TECHLIB database. BASIS WEBServer Gateway is already implemented in IDI customer libraries where it provides distributed access to library systems and services.

The third tier is the server where the actual data is resident and where all the complex transactions and retrievals occur. The server can be an NT or a UNIX server, or a Digital VMS server.

While the architecture is multi-tiered, each tier does not require a separate computer. Where UNIX is used for the database server, a single NT machine can be the TECHLIB application server and the librarian's workstation. IDI believes that the new architecture will support scalability and performance at the database server level. It will also support the power of the Microsoft development environment in the middle tier. This is a choice that will appeal to IDI's Global 2000 customer base.

Database Management System

IDI underscores the flexibility of its BASIS relational database management system (RDBMS), which has been optimized for text, documents, and objects. The database that supports the BASIS TECHLIB system is BASIS V8.2, which IDI describes as an extended relational database designed specifically for managing text and document objects, and their attributes and relations. IDI considers the performance, security, and integrity of its RDBMS, with its fully integrated search engine, to be its primary strength.

BASIS can store and manage over 250 document types; recognize and manipulate both unstructured and structured documents; and store and retrieve mixed document components such as text, images and multimedia objects. The database structure supports large records, large fields, and multiple occurring fields, so that a complete bibliographic entry or full-text document is stored in a single database table. A document is stored in the database and is fully indexed upon input.

In addition to the highly structured data (such as name, address, phone number) traditionally supported by relational databases, BASIS tables also contain unstructured data. The unstructured data is typically in the form of large fields containing words and other mixed objects. The highly structured data usually consists of attributes that describe documents or document objects and their relationships in the database.

The report writing facility in BASIS TECHLIB is provided by Seagate Software's Crystal Reports. In addition, all of the BASIS TECHLIB reports use Microsoft Access as an intermediate file to improve ease of formatting output. BASIS is compliant with ODBC and SQL for accessing and querying the database so that system administrators have access to the RDBMS through standard tools.

Search Engine

BASIS allows many different types of query such as phrase searching, proximity searching, wildcard searching and weighting, in addition to traditional operators. In addition, IDI integrates BASIS with

other searching, filtering, and viewing technologies from third-party vendors like Inso, IntelliScope, OutsideIn, KEYview, KEYpak, and Adobe.

Network
TECHLIB operates in LAN/WAN environments and uses TCP/IP communications protocol for Internet, intranet, and extranet networking.

BASIS TECHLIB Computing Environment

Architecture	Three-Tier Client/Server
Operating System:	
Client	Any operating system that can support Microsoft Internet Explorer 3.02/4.01, or Netscape Communicator 4.03
Server	Windows NT Server with Service Pack 3 Microsoft Internet Information Server (IIS) 3.0 or 4.0
Database Management System	RDBMS: BASIS
Search Engine	BASIS
Hardware:	
Client	Any workstation that can support Microsoft Internet Explorer 3.02/4.01, or Netscape Communicator 4.03.
Server	NT (Intel) or UNIX (IBM, HP, Sun) system with minimum configuration of: Pentium 200MHz processor; 256 MB RAM 500 MB, disk for system 2X source data, disk for databases A larger processor is recommended if the NT system is also the BASIS database server.

Standards
Among the standards that have been incorporated into BASIS TECHLIB are Z39.2 (USMARC and several national variants), Z39.19 (thesaurus), Z39.50 for searching external databases and supporting query of TECHLIB databases (although Z39.50 is not used for internal TECHLIB queries in favor of the HTTP and proprietary BASIS protocols, which IDI considers more robust). BASIS TECHLIB is compliant with Level 1 of ODBC v2.0, with some Level 2 functionality, and with a variety of SQL features. BASIS TECHLIB is Year 2000 compliant, as BASIS has always used "yyyymmdd" date formats.

Security

Security is available at different levels in the system. The BASIS TECHLIB implementation using Microsoft Active Platform takes advantage of the security capabilities provided at each tier: by the Windows NT server, by Internet Information Server, and by BASIS. In addition, Intranet installations provide firewall protection. BASIS TECHLIB maintains user context or state via the Active Server Pages so the server-based BASIS security features are active. BASIS security provides separate restrictions to control user access to information and to authorize user update privileges (i.e., add, update, delete). Security locks can be enforced by application, user groups, user, record type (table), or views. In addition, the BASIS TECHLIB application separately authenticates user privileges at the module (e.g., cataloging, circulation), and the task (i.e., catalog maintenance, authority maintenance, check-out, holds processing) levels.

Interface Design

BASIS TECHLIB's OPAC for Intranets provides access to the library catalog via the World Wide Web. Using a Web browser, OPAC for Intranets provides access to the library catalog and links to other information sources. OPAC for Intranets uses HTTP and IDI's proven BASIS WEBServer Gateway technology. Other BASIS TECHLIB modules also operate via the Web browser. TECHLIB supports searching of the library catalog, any Z39.50 compliant database, as well as any BASIS document database, using OPAC for Windows, which provides Z39.50 search capability.

Technical Support

IDI management believes that referrals from current customers are the key to future business. IDI says that it assigns a high priority to servicing its customers. IDI customer support includes consulting services, a toll-free support phone line, installation support, documentation, training classes, and a BASIS user group. An IDI representative is assigned to each customer.

Training and Documentation

IDI provides initial implementation support and additional consulting assistance as needed for customization or administration. Formal classroom seminars are provided at IDI regional locations. Onsite training can be arranged in classroom or tutorial mode.

Complete documentation for both BASIS and BASIS TECHLIB is provided in online and print formats. BASIS TECHLIB user documentation is provided as online help with topics at the module, task, and field level. The online help system, which is maintained in a separate BASIS database, is also fully searchable via keyword or phrase.

Planned Future Releases

IDI is now roughly at two releases per year. Usually one of those is a major feature/function release. The other is typically a point release that would be for maintenance or perhaps minor feature enhancements or tuning. IDI is moving to shorter release cycles, as it recognizes that the company cannot afford to hold back a release that needs to be in the field. IDI believes its various releases are highly compatible so a customer can skip a release, then install a later release without problems. Compatibility between clients and servers permits a customer to install a new version of the client software without upgrading the server software.

ADAPTING BASIS TECHLIB TO LIBRARY NEEDS

Overall Adaptability

BASIS TECHLIB is based on extensive use of parameter tables, so that screen designs and other library preferences can be customized without the need for programming expertise. A special library can extensively configure BASIS TECHLIB to accommodate unique local requirements and to integrate custom functions while still allowing implementation of new product features and enhancements.

The BASIS database is accessible through the use of industry-standard tools. IDI provides access into its proprietary environment via standard ODBC, as well as API and BASIS utility programs. Libraries can add fields to their TECHLIB database, add or change indexing, change screen layout, or create custom reports. Thus, IDI believes it achieves the necessary level of performance, scalability, and richness of functionality through its own development, combined with access to its technology through standard interfaces.

Support for Effective Workflows

Through its work with corporate and special libraries, IDI believes that the differences between one special library and the next are far more substantial than the differences between one public library or one academic library and the next. For this reason, TECHLIB has been developed to allow a high level of flexibility. IDI indicates that it always tried to put in more than one path to accomplish a particular task.

Data Interfaces: IDI supports import and export of MARC bibliographic and authority records. EDI ASC X12 and EDIFACT transactions are planned for implementation in serials and acquisitions in BASIS TECHLIB V8.3. Other simple output formats (for serials holdings statements, for example,) are readily available, although not explicitly supported.

Local Processing: IDI believes that an automated library system needs to reflect the library environment and not impose itself on daily operations. Through extensive use of parameters, BASIS TECHLIB supports variation in library policies for single and multiple library organizations without need for customization.

Migration/Transition: IDI provides a continuous upgrade path for its customers migrating from earlier TECHLIB systems, while retaining the existing database. BASIS TECHLIB is a modular system so that libraries can purchase only those features needed.

STRATEGY FOR NETWORKED INFORMATION

IDI's strategy for supporting networking information is based on the long-term vision of the library system as key to providing access to an organization's information resources. In IDI's view, the information management aspect of the library system is ultimately much more important than the material and inventory management, particularly as electronic information increasingly replaces print.

TECHLIB Functions Availability

Function	Status	Availability
Acquisitions	TECHLIBplus	Now
Cataloging	BASIS TECHLIB pre-release	Now
Circulation	BASIS TECHLIB pre-release	Now
Electronic Reserves	—	—
Interlibrary Loan	TECHLIBplus	Now
Media Booking	—	—
Serials	TECHLIBplus	Now
OPAC		
Interface to CD-ROM Server	OPAC Gateway	Now
Z39.50 Gateway Search	OPAC for Windows	Now
Full-Text Retrieval	OPAC Gateway	Now
Full-Text Search	OPAC Gateway	Now
Graphical User Interface	OPAC Gateway	Now
Multimedia Retrieval		
Images	OPAC Gateway	Now
Audio	OPAC Gateway	Now
Video	OPAC Gateway	Now
Bibliographic Records Import/Export	TECHLIBplus	Now
Authority Control Import/Export	TECHLIBplus	Now
Standards Compliance		
Z39.2 (MARC)	Version 1	Now
Z39.50	Version 1	Now
EDIFACT	In development	1998
Unicode	—	—
Year 2000 Ready	BASIS and TECHLIB	Now

Support for Emerging Data Formats
In BASIS TECHLIB, the Electronic Collections module provides a repository for electronic documents cataloged and managed by the library. Documents, which may include full-text, images, or multimedia are checked in during cataloging, and linked to bibliographic metadata. Using hyperlinks, the documents may be displayed using the OPAC. An optional OPAC feature may be defined to enable full-text retrieval of archived documents.

Support for Electronic Payments
In earlier versions of TECHLIB, processing invoices and supporting credit cards for purchases have been handled through acquisitions. As IDI designed the new system, it looked closely at the payments processes and, from discussions with focus groups, found that most of the payment and purchasing activities need to be handled in the corporate purchasing system. IDI reported that there is little demand for supporting payments by individual patrons. IDI is continuing to do more evaluation and analysis to determine what the future need may be.

PRODUCT DEVELOPMENT INFRASTRUCTURE

Product Development and Enhancement
In developing the specifications for the next generation TECHLIB, IDI recruited customers to review specification documents and to clarify requirements for the new system. Throughout development, IDI has exposed customers to prototype versions that the company builds with rapid development tools. Once various components of the new system are in pre-release, IDI provides private URLs for customers to connect into the system for testing and evaluation of usability and of the interface. IDI considers this an ideal way to get customer feedback before the new system is fully documented, and in a way that does not require customers to install the systems locally. IDI reports that it spends roughly 20% of annual revenues on research and development.

Development Partnerships and Technology Licensing
Information Dimensions maintains a network of strategic partnerships with other information industry service providers. These partners include Microsoft Corporation, Netscape Communications, Hewlett-Packard, Digital, Silicon Graphics, Sun, IBM, Cap Gemini Sogetti, Powerserv, and IBM/ ISSC.

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

When IDI was purchased from OCLC by Gores Technology Group, IDI joined a holding company consisting of other technology companies.

CORPORATE ORGANIZATION AND OFFICES

Corporate Headquarters
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Sales, Distribution and Support
IDI products are sold and marketed through the company's direct sales organization headquartered in Dublin, Ohio, with sales offices in the United States and in France, Germany, Sweden, and the U.K. Distributors and agents provide sales and service in other parts of Europe, the Middle East, Africa, India, Latin America, and the Pacific Rim. The company also uses value-added resellers (VARs) to offer customized solutions.

In early 1998, IDI and Maxcess Corporation announced a joint marketing agreement, in which Maxcess has become a distributor of IDI's BASIS TECHLIB system. [3]

Company Executives
M. William (Bill) Forquer, President and CEO
George Shemas, Vice-President of Product Development
Jacques Potier, General Manager, European Operations

FINANCIAL STATEMENT

IDI reported that 1997 revenues were approximately $20 million.

RELATED REFERENCES AND URLs

1. See Gores Technology Web site at http://www.gores.com.

2. For a detailed description and discussion of TECHLIB characteristics, see William Saffady, "Vendors of Integrated Library Systems for Minicomputers and Mainframes: An Industry Report, Part 1 [Information Dimensions Incorporated]." *Library Technology Reports* 33, no. 2 (March/April 1997): 219-227.

3. See Maxcess Corporation Web site at http://www.maxcesscorp.com.

Sources: Interviews with Bill Forquer and Carol Knoblauch of Information Dimensions Inc.; IDI product literature and TECHLIB product description; and IDI Web site.

Innovative Interfaces, Inc.

SUMMARY

Major themes of Innovative Interfaces' strategy are: providing breadth and depth of functionality through its library system modules, helping libraries with system integration, and managing costs of hardware and system administration. With more than 600 customers worldwide, Innovative's customer base is weighted to academic libraries, medium-to-large public libraries, and consortia. Innovative announced that it will evolve to a next generation of INNOPAC, called Millennium, which is being designed to support Java and "thin client" technology in a client/server environment. Innovative has released the first Millennium components, a Web OPAC, Web Access Management, and Web Management Reports. Innovative Interfaces supports libraries in accessing networked information through a variety of capabilities. Challenges facing Innovative Interfaces in the next year include delivering all INNOPAC/Millennium modules that have been announced and achieving the goal of 100% customer retention, as other vendors also are introducing library systems based on new technologies.

INNOVATIVE INTERFACES, INC.

URL: http://www.iii.com

Ownership

Founded in 1978, Innovative Interfaces, Inc. is privately held. Its founders, Steve Silberstein and Jerry Kline, remain active in the day-to-day management of the company.

BUSINESS DIVISIONS/UNITS

The sole focus of Innovative Interfaces is the development and worldwide marketing of its INNOPAC library management system. Innovative's corporate headquarters are in Emeryville, California, with additional offices in Australia, Taiwan, Canada, the U.K. (European Headquarters), Thailand, Sweden, Spain, and Portugal. In 1996, Innovative acquired SLS Information Systems, a vendor of integrated library systems in Europe. [1]

PRIMARY PRODUCTS AND SERVICES

Innovative develops and markets a single product line based on the library management system, INNOPAC. Introduced nearly twenty years ago, Innovative's first library management system module, INNOVACQ, was recognized for its advanced functionality as an acquisitions and serials control system. Today, the integrated INNOPAC library system contains seven core modules and is designed to run on dedicated computer systems installed at the customer site.

Innovative also offers a facilities management service called INN-Keeper for libraries that prefer to operate their system from a database loaded on the UNIX server located at Innovative headquarters in Emeryville. The company reports that INN-Keeper was installed in 1997 by Western State University College of Law, in Fullerton, California, and Thomas Jefferson School of Law, located in San Diego.

In 1996, Innovative announced that it would evolve to a next generation of INNOPAC, called Millennium. Millennium provides the traditional INNOPAC functionality by a new Web interface and system architecture. It is designed to support Java and "thin client" technology in a client/server environment. Innovative has released the first Millennium components, a Web OPAC, Web Access Management, and Web Management Reports.

Innovative purchased SLS Information Systems in April 1997 and took over support for its LIBERTAS system. LIBERTAS is currently installed in 100 university libraries in the U.K., Sweden, Spain, and Portugal. The company plans to support LIBERTAS for five years and is in the process of transitioning SLS customers to the INNOPAC and/or Millennium systems.

PRIMARY MARKETS

Innovative's target markets are U.S. public and academic libraries and consortia, international accounts in the same categories, and the company's current customer base. With more than 600 customers worldwide, the company reports that 70% of its customer base are academic libraries and roughly 30% are public libraries. Innovative also has special and government libraries such as the Executive Office of the President, the Mayo Clinic, and the National Institutes of Health. Research libraries, including many members of the Association of Research Libraries (ARL), comprise Innovative's largest customer segment. Liberal arts and teaching institutions, such as the Oberlin 50, account for another significant number.

In seeking growth opportunities, Innovative plans to expand globally into the same segment of the market that has been its traditional strength in the U.S. and Canada (the academic research library and the medium-to-large public library). Innovative asserts that it is currently the largest provider of library management systems in the Pacific Rim and Australia.

Innovative estimates that 60% of its customer libraries hold over 400,000 titles in their collections. The company supports over 1,200 actual libraries, spread over 800 server installations. Innovative reports that it installs approximately 10 systems per month. Several hundred Innovative customers are listed on the company's Web site with hotlinks to libraries' Web sites.

OVERALL STRATEGY

Major themes of Innovative Interfaces' strategy are: providing breadth and depth of functionality through its library system modules, helping libraries with system integration, and managing costs of hardware and system administration. Innovative's 600 plus customers are predominantly academic libraries, medium-to-large public libraries, and consortia. Innovative announced that it will evolve to a next generation of INNOPAC, called Millennium, which is being designed to support Java and "thin client" technology in a client/server environment. Innovative has released the first Millennium

components, a Web OPAC, Web Access Management, and Web Management Reports. Innovative Interfaces supports libraries in accessing networked information through a variety of capabilities. Challenges facing Innovative Interfaces in the next year include delivering all INNOPAC/Millennium modules that have been announced and achieving the goal of 100% customer retention, as other vendors also are introducing library systems based on new technologies.

Innovative's overall strategy is to maintain and expand its position as a leading worldwide supplier of library systems. Innovative's key goals are 100% retention of its customer base, continued international growth, and attracting new customers by adding new functionality to its INNOPAC system. Innovative reports that it plans to retain its client base by positioning current INNOPAC customers for an evolutionary growth path to a thin client architecture. Innovative hopes to contrast this approach with competing companies which are delivering traditional client/server-based library systems, which Innovative asserts can have radical software revisions that can compromise basic expected functionality and prove difficult and costly to manage. Major themes of Innovative Interfaces' strategy are: providing breadth and depth of functionality through its library system modules, helping libraries with system integration, and managing costs of hardware and system administration.

Functional Breadth and Depth

Innovative professes to be less interested in overall volume growth as in growth that adds value to the product by the creation of new functionality. For example, the sales of Innovative systems to libraries in Estonia, Egypt, and China resulted in the development of full support for Cyrillic, Arabic, and Chinese character sets.

System Integration

Innovative sees its role in the late 1990s and into the next century as one of assisting libraries in the process of system integration. Innovative points to the Web as the most important of the integration tools. The company's view is that widespread acceptance of the Web led to the company's choice to develop thin-client technology. They did so even as other vendors are creating Windows-based, or other "fat client" interfaces. Innovative points out that it has had a Web-based OPAC in release for over four years.

Managing Costs

Innovative asserts that the economic constraints faced by libraries today make it imperative that they maximize the use of existing computer hardware. They are limiting their investment in expensive and maintenance-intensive PC clients. For this reason, Innovative is developing Millennium to use existing hardware and to utilize thin clients or Network Computers (NCs). The company predicts that NCs will become a popular choice in the library marketplace for their low cost, ease of maintenance, and resistance to the traditional PC obsolescence.

MILLENNIUM

Innovative's strategy is reflected in the evolution of its host-based UNIX library management system, INNOPAC, into the client/server, Web-based Millennium. The company has announced that it plans

to make all of the INNOPAC software modules available via the Web through the incorporation of Java applets and thin client technology.

INNOPAC is a single product with various modules that are fully integrated. Traditional hallmarks of the INNOPAC system are its high degree of functionality; ease of use; support for Web, Z39.50, and character-based interfaces; seamless integration of all modules; and management information support. The INNOPAC core modules are: Cataloging; Online Public Access Catalog; Acquisitions; Serials Control; Circulation, including Reserves; Materials Booking; and Interlibrary Loan.

Millennium is based on the INNOPAC foundation. Innovative reports that when all Millennium components have been delivered, Millennium will include most of the functionality of INNOPAC, with new capabilities afforded by the thin client environment. Millennium Web Management Reports was Innovative's first Java-based module to be released.

The Millennium Approach

With its Millennium strategy, Innovative's intent is to provide a system that meets libraries' need for what Innovative sees as "technologically current but manageable solutions," with the goals of retaining its INNOPAC customer base and attracting new customers that plan to migrate to another library system.

For libraries choosing Millennium, the Millennium components will co-reside with the INNOPAC character-based system. Libraries may operate Millennium components and INNOPAC simultaneously on the same UNIX-based server. The company's perspective is that this approach has the advantage of allowing libraries time to go through several budget cycles to replace the old character-based peripheral devices with NCs or Java-enabled workstations.

MILLENNIUM TOOLS/FEATURES [2]

Architecture

Millennium employs a thin client architecture using a central server and a core database with shared functionality across all areas. Both data and applications reside at the server level and are delivered to the desktop using Java and HTML. The vision for Millennium is that Java applets for all Millennium modules will allow users to download "mini" applications as needed. Libraries will be able to continue using traditional PC workstations or network computers designed to run Java applets. The operating system is UNIX. INNOPAC currently runs on virtually all UNIX platforms. The server software is written in C programming language. Innovative reports that eventually it will go to pure Java for development.

Because of its Java-based thin client architecture, Innovative believes libraries will benefit from not having to migrate from existing central servers. With thin client architecture, the server carries the burden of all applications so that thin clients can be used, thus reducing future costs of workstation hardware upgrades. Innovative reports that an important long-term advantage of its approach is that only one version of client software will have to be written. As a result, software maintenance and updating will be simplified considerably because there is only one version of the program to update. Client software can be updated through downloads from the server.

Database Management System

Data in Millennium is stored in Innovative's proprietary database management system (DBMS). Innovative has no plans to use a third-party DBMS, asserting that providing its own proprietary database ensures Innovative customers will receive better support. The company reports that its DBMS is accessible through APIs as well as through Innovative's report generator and statistical reporting packages. Innovative indicates that Standard Query Language (SQL) access via third-party tools is in development and should be available in 1998.

Both fixed and variable length fields are supported. Innovative supports full MARC formats for both bibliographic and authority records. The library can define which fields it wants included in different record types and can select which fields will be indexed. Innovative supports the special characters in the ALA character set, as well as the CJK, Thai, Hebrew, Arabic, and Cyrillic character sets.

Innovative reports that there is no upper limit to the size of database that can be supported. Many of the company's customers have INNOPAC databases numbering in the millions of records.

Search Engine

INNOPAC uses two search engines, one developed by Innovative Interfaces and the other licensed from Fulcrum Technologies, [3] for which Innovative has a source code license. Millennium incorporates relevance ranking for advanced full-text searching, in addition to browsing and keyword searching using standard Boolean operators. Innovative provides both client and server Z39.50 support (partial version 3) and offers electronic gateways to other systems and databases through Z39.50, Gopher, or Telnet.

Millennium Computing Environment

Architecture	Thin Client
Operating System:	
Client	Any operating system that can support a browser: Windows, Macintosh, UNIX
Server	UNIX
Database Management System	Innovative Interfaces proprietary DBMS
Search Engine	Innovative Interfaces proprietary; Fulcrum
Hardware:	
Client	Windows, Macintosh or UNIX workstations; or Network Computers
Server	UNIX servers

Network
Innovative supports international communications and networking standards such as TCP/IP and HTTP.

Standards
Innovative has traditionally supported and encouraged development of international library and communications standards, including Z39.2 (USMARC and international variations), Z39.50 (version 3, 1995), and EDI ASC X12. The company supports the emerging ISO interlibrary loan protocols and EDIFACT.

Security
Innovative provides three levels of system security. Password access allows only authorized users to perform protected functions. Certain functions can be limited only to certain terminals or IP addresses. All changes to the database are logged in a separate transaction log file.

Interface Design
The latest version of Innovative's Web OPAC makes limited use of Java. The Millennium Web Management Reports module makes more extensive use of Java, allowing users to create management and statistical reports, charts, graphs, and tables via a Web browser. The company reports that other Java-based interfaces will be introduced in 1998 for other system modules. The exception will be the Cataloging module, which has a recently introduced Windows interface. Innovative expects that technical services will continue to need desktop access to a variety of tools to support the cataloging functions, making a PC workstation more logical than thin client or NC implementation.

Technical Support
Innovative does not distinguish between technical and applications support, the rationale being it is often difficult to determine easily whether a problem has to do with hardware, operating system, network connections, or application software. Implementation services (including trainers, data load specialists, software configuration personnel, and parameterization specialists) report through the same management line as technical support.

Training and Documentation
Innovative offers fee-based training workshops for current customers at locations throughout the U.S. Innovative's documentation department completes documentation for all new products before they are released. The company recently released a Web version of its 800-page paper "Getting Started" implementation manual. The manual features context-sensitive help, hyperlinks, and support for Web submission of implementation forms.

Planned Future Releases
INNOPAC is currently in Release 11. One release per year is a company commitment. As mentioned earlier, Web OPAC and Java-based management reports are currently available.

According to Innovative's marketing literature, Innovative currently is focusing on Java applets for the Millennium interface, because possible bandwidth limitations in some libraries might limit their ability to utilize entire Java applications. The company has reported that as network bandwidth increases, it plans to make more extensive use of Java.

INNOPAC/Millennium Functions Availability

Function	Status	Availability
Acquisitions	INNOPAC;*Millennium*	Now;*1998?*
Cataloging	INNOPAC	Now
Circulation	INNOPAC;*Millennium*	Now;*1998?*
Electronic Reserves	INNOPAC	Now
Interlibrary Loan	INNOPAC	Now
Media Booking	INNOPAC	Now
Serials	INNOPAC;*Millennium*	Now;*1998?*
OPAC		
Interface to CD-ROM Server	INNOPAC; *Millennium*	Now;*Now*
Z39.50 Gateway Search	INNOPAC;*Millennium*	Now;*Now*
Full-Text Retrieval	INNOPAC;*Millennium*	Now;*Now*
Full-Text Search	INNOPAC;*Millennium*	Now;*Now*
Graphical User Interface	INNOPAC;*Millennium*	Now;*Now*
Multimedia Retrieval		
Images	INNOPAC;*Millennium*	Now;*Now*
Audio	INNOPAC;*Millennium*	Now;*Now*
Video	INNOPAC;*Millennium*	Now;*Now*
Bibliographic Records Import/Export	INNOPAC	Now
Authority Control Import/Export	INNOPAC	Now
Standards Compliance		
Z39.2 (MARC)	INNOPAC;*Millennium*	Now;*Now*
Z39.50	INNOPAC;*Millennium*	Now;*Now*
EDIFACT	INNOPAC	Future
Unicode	—	—
Year 2000 Ready	?	?

ADAPTING MILLENNIUM TO LIBRARY NEEDS

Traditionally Innovative's policy has been not to provide root access to the system; any customization of the software was performed by Innovative, then turned back into general release to all customers. For Millennium, Innovative has announced that it will offer APIs (Application Program Interfaces) to allow libraries to extract library data or to create interfaces to other systems.

Overall Adaptability

The INNOPAC system is highly parameterized, and Innovative reports that most customers find this gives them the customization they need. Innovative's Web-server gives libraries the ability to customize the look of the OPAC interface. Using graphics tools or HTML, it is possible to change the "look and feel" of the catalog interface without altering functionality.

The annual release is self-installing. Innovative discovered through its focus groups that customers wanted to install upgrades on their own schedule, without heavy involvement from the vendor. Once a new release is made generally available, the library can dial into a special IP address and execute an upgrade on its own timeline.

Support for Effective Workflows

Data Interfaces: Innovative recognizes that work processes are changing in the technical services area of libraries. More cataloging data can now be collected and processed during the acquisitions process than ever before. Innovative's acquisitions and serials control modules offer full support for downloading bibliographic records from the bibliographic utilities or from book vendors, following pre-order searching. INNOPAC supports electronic interfaces for orders, invoices, claiming, and other transactions with most major book and serials vendors, using BISAC, SISAC, and EDI ASC X12 standards. Innovative announced in 1997 that it plans to implement EDIFACT transmissions in cooperation with Blackwell's Book Services.

Local Processing: Innovative's customers already benefit from work the company has carried out to streamline interlibrary loan processes. Innovative is a member of the NAILLD Interlibrary Loan Protocol Implementor's Group (IPIG) and has tested with OCLC and put in production a set of required and optional messages defined by the ISO ILL Protocol (10160 & 10161). [4]

Innovative supports efficient cataloging processes through its INNOPAC Windows Cataloging Software, which provides the ability to retrieve bibliographic records from any Z39.50-compliant system, such as the Library of Congress or OCLC. Once located, a record can be loaded into the INNOPAC system. Through the use of standard Windows capabilities, the cataloging client provides multiple windowing, drag-and-drop functions, and a customizable user interface.

Migration/Transition: Innovative has migrated many libraries to INNOPAC from various library systems. The company supports standard import and export routines for bibliographic and authority records in MARC format.

STRATEGY FOR NETWORKED INFORMATION

Innovative Interfaces supports networked information through a variety of capabilities, and the company reports that it plans major future developments.

INNOPAC supports local loading of reference databases via INN-View, a host computer system which offers databases and record enhancement services. Databases loaded on INN-View are accessible via the INNOPAC OPAC. INNOPAC software also supports local loading and creation of community information files. INNOPAC support for the linking by the MARC 856 field lets library patrons automatically link from library holdings to full text and images on the Internet or on local resources on their own Intranet. Innovative's Web Access Management software provides patron authentication for users in off-campus locations who need to use commercial databases via their INNOPAC systems.

Support for Emerging Data Formats

In support of the growing need to manage new information formats, Innovative is contemplating development of comprehensive imaging technology and image management capabilities. In what would be a major development initiative, Innovative would integrate into Millennium copyright management, fee-collection support, and viewing/printing sophistication for multimedia content. Innovative anticipates one hurdle in delivering these capabilities may be a lack of bandwidth on library networks to support these large files.

Support for Electronic Payments

Innovative anticipates developing a major new accounting module to support electronic commerce through the library system. The company describes the need for an all-encompassing accounting system integrated with every module of the library system.

PRODUCT DEVELOPMENT INFRASTRUCTURE

Product Development Process

Innovative reports that it holds 20 to 30 focus groups per year, which feed ideas into a five-step product development process:

- Concept Paper. This attempts to reflect a marketplace need and define where the company wants to develop.
- Specification. During this phase the product manager defines how the product will look, work, and integrate into the total INNOPAC product.
- Prototype. The prototype is tested internally by a variety of people—trainers, sales staff, and management.
- Product Development. This step turns the prototype into a fully functioning program, with documentation included.
- Product Testing. This involves placing the product into alpha sites, and then beta sites.

Innovative reports that the entire process takes 12-18 months, and at the end of the cycle the product is released to the public.

Product Enhancement
Innovative develops product enhancements based on information obtained from customers in focus groups and sales calls. The company has a strong commitment to a single annual release and creates no custom code. As new sites are installed that may have contractual requirements for new functionality, Innovative will release a ".1" release midway through the year. This release includes those changes and enhancements. At the time of the next annual release, all .1 functionality is rolled into the general release and made available to the entire customer base.

Development Partnerships and Technology Licensing
In a large-scale and highly visible development partnership with a customer, OhioLink, Innovative linked with various other vendor systems (NOTIS, GEAC, LS2000) to exchange circulation data and facilitate user-driven resource sharing among the OhioLink libraries.

In general, Innovative avoids licensing and use of third-party software, believing that its customers benefit from Innovative retaining control over development. An exception mentioned earlier is Innovative's use of Fulcrum search engine capabilities.

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

Innovative purchased SLS (Information Systems) Limited, a European library automation supplier, in April 1997. Innovative completed the transaction as a cash purchase of 100% of all SLS stock from 16 university shareholders in the United Kingdom. The purchase included the entire SLS U.K. operation and two subsidiaries in Stockholm and in Madrid. Innovative will continue to support the SLS LIBERTAS product for five years while it actively migrates SLS libraries from the LIBERTAS system to the INNOPAC system.

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Sales, Distribution and Support
Innovative has seven field sales people in the United States and markets its products through sales offices and subsidiaries in Australia, Taiwan, Canada, the U.K., Portugal, Spain, Sweden, and Thailand. In line with Innovative's goal of 100% customer retention, the company believes that "referral selling" is perhaps the most effective way of selling to the library market.

Company Executives
Jerry Kline, President and CEO
Steve Silberstein, Executive Vice President
Bob Walton, Executive Vice President and Chief Financial Officer

FINANCIAL STATEMENT

The company reported that annual revenues exceed $60 million.

RELATED REFERENCES AND URLs

1. SLS Information Systems' Web site: http://www.sls.se.

2. For a detailed description and discussion of INNOPAC characteristics, see William Saffady, "Vendors of Integrated Library Systems for Minicomputers and Mainframes: An Industry Report, Part 2 [Innovative Interfaces, Incorporated]." *Library Technology Reports* 33, no. 3 (May/June 1997): 345-357.

3. See information on Fulcrum Alliance Network members at Fulcrum Technologies' Web site: http://www.fulcrum.com/.

4. For more information about the North American Interlibrary Loan and Document Delivery (NAILDD) Project, see http://www.arl.org/access/naildd/naildd.shtml.

Sources: Interview with Innovative's Bob Walton, Susan Pagani, and Russell McDonald, INNOPAC Millennium product literature, INNOPAC System Overview, and Innovative Interfaces Web site.

SIRSI Corporation

SUMMARY

Long-term vision and creative use of technology are key aspects of SIRSI's strategy. The Unicorn Library Management system is installed in public, K-12, academic, and special libraries worldwide, with the majority of SIRSI customers in the United States. SIRSI's design philosophy is reflected in Unicorn, a mature client/server system that has fully developed functionality, is highly flexible, and utilizes an open design. In its WorkFlows product, SIRSI has further developed Unicorn to help libraries streamline their work processes and to improve staff productivity. SIRSI's strategy for networking information is driven by the view of supporting an integrated information environment. In such an environment, library staff and users have access to integrated internal and external resources. SIRSI's challenges for the coming year include introducing its customer base to the WorkFlows concept and product, and delivering new EDIFACT and ILL development commitments.

SIRSI CORPORATION

URL: http://www.sirsi.com

Ownership

SIRSI Corporation, which was founded in 1979, is privately held. The company founders continue to lead the company as the top management team.

BUSINESS DIVISIONS/UNITS

SIRSI Corporation has two divisions: Library Products Division and Digital Media Archive Division. The Library division develops the Unicorn library system product line and related offerings and services. The Digital Media division was formed in 1995 to develop technology and services to support creation and management of digital archives.

PRIMARY PRODUCTS AND SERVICES

The Unicorn Library Management System has been customized and packaged to meet the needs of different library market segments:

Unicorn—A UNIX-based, client/server library management system in which all modules are integrated and operate from a common bibliographic database.

UnicornACADEME—The Unicorn system for academic libraries, with special functions of reserves, technical services, online interfaces, administration, and campus and Internet networking.

UnicornECOLE—The Unicorn system packaged and priced for the school library market with graphical interfaces. Reports and policies are configured specifically for school libraries.

UnicornOASIS—Unicorn for public libraries. Special features include a photo-icon interface, preconfigured reports, and policies designed for public library needs. Optional modules are: ReferenceLIBRARIAN, with over 1,000 preconfigured searches of the library's catalog; and Outreach Services, for automated selection, delivery, and return of items to remote patrons.

UnicornSL—Unicorn for special libraries.

UnicornSTILAS—Adds to Unicorn special features designed for technical libraries. Created for Department of Defense libraries, UnicornSTILAS includes interoperability and security compliance features needed by technical libraries dealing with accountable materials in secure environments.

SIRSI also offers products that interface with Unicorn:

- WebCat, a Web interface that can be added to Unicorn or to other Z39.50 compatible library systems.
- InfoVIEW, a Z39.50 searching client.
- WorkFlows, a Windows 95/NT client designed for technical services. WorkFlows guides users through library tasks and aids in redesigning work processes for greater efficiency.

InfoBASE is a full-text data warehouse Z39.50 server that can be integrated with Unicorn or implemented as a standalone server.

SIRSI's Digital Media Archive Division produces the **Hyperion Digital Media Archive System** to support the media capture, registration, search, retrieval, and administrative requirements of digital collections. Hyperion can be implemented as a standalone archive or integrated with a Unicorn system. The Digital Media division also offers consulting services related to digitization and archiving projects.

PRIMARY MARKETS

As of January 1998, SIRSI had 769 Unicorn library management systems installed, serving 1,628 libraries worldwide, with the majority of installations in the United States. The company reports that its customers are distributed across public, K-12, academic, and special libraries. [1] While SIRSI's customer base has been dominated traditionally by small to medium sized libraries, Unicorn's functionality and scalability supports libraries of any size. Unicorn is currently installed in libraries ranging from a few thousand titles to millions of titles, including a dozen members of the Association of Research Libraries.

OVERALL STRATEGY

SIRSI's overall strategy is to serve all types of libraries through technology that moves libraries and their users toward a single environment for access to all information resources.

The company's goal as an organization is "to innovate information products and to see people using them successfully." SIRSI's major short-term goal is to work with its customer base to "rethink" the way library management systems are being used in the library and to identify new opportunities for the library system as a management tool. The WorkFlows project is one result of this re-examination effort. Taking a long-term view and creative use of technology are strong threads in SIRSI's strategy.

Long-Term View
From the beginning, SIRSI's founders wanted to develop a library system that would have a long lifecycle. SIRSI chose at the outset to adopt a UNIX-based client/server environment for Unicorn. It has continued to develop and enhance the same system since 1982. Today, Unicorn is a single library system that has the openness and robustness to serve all types and sizes of libraries. Unicorn was created early, with client/server architecture that other library systems vendors are now introducing, to create greater openness and flexibility.

Creative Use of Technology
SIRSI believes in harnessing technology to serve libraries better. SIRSI also believes that the integrated library system still has a lot of opportunity to be a significant management tool in libraries. The company would like to see a focus on new ways that library systems can be used to benefit staff and management through increased productivity and effectiveness.

UNICORN

SIRSI's philosophy is reflected in the Unicorn system. It is a mature client/server system that has fully developed functionality, is highly flexible, and utilizes an open design. Unicorn has been available since the early 1980s and has progressed through ten major releases. The system, while fully integrated in its operations, is also modular, allowing libraries to choose the combination of modules to be added to the central database module. Modules include: Authority Control, Enhanced Public Access, Circulation, Acquisitions, Serials Control, Academic Reserves, Materials Booking, Information Gateway, Outreach Services, Accountability, Request Desk, and Reference Librarian. A variety of interfaces and clients are also available. Key aspects of the Unicorn strategy include: open design, flexibility, and productivity enhancement.

Open Design: Unicorn employs an open design and adheres to standards embraced by the information industry and the library community.

Flexibility: Unicorn is a single system which SIRSI has customized to meet needs of different library types through customized interfaces and pre-configured parameters. Because Unicorn is highly parameterized, libraries have considerable flexibility in adapting the system to local requirements.

Productivity Enhancement: SIRSI's major emphasis in the last two years has been on further developing Unicorn to help libraries streamline their work processes and to improve staff productivity through underlying technology support. The WorkFlows project is one outcome of this development focus on the library system as a management and staff tool.

UNICORN TOOLS/FEATURES [2]

Architecture

SIRSI was the first company to develop a library system based on client/server architecture when it offered Unicorn in 1982. The company has continued to develop in a UNIX-based client/server environment from that time. Unicorn employs a three-tier client/server architecture in which the application programs are separate from the databases. In Unicorn, all interaction with the databases is performed on the server through a suite of applications software. On the client side, another set of software handles user interface processing. Typically, multiple workstations interact with one server. All the client and server functions can, however, run on one computer to support dumb terminals if necessary.

Unicorn is scalable and supports any hardware platform that runs the UNIX operating system, from PCs to large servers. Unicorn customers can upgrade their hardware configuration or change their networking environment readily in Unicorn's UNIX environment. SIRSI uses a questionnaire to help libraries target minimum requirements based on number of users and records, and intended use.

Database Management System

SIRSI has taken a unique approach to database management by using both a relational database management system (RDBMS) and a text database that are fully integrated in a way that is transparent to the Unicorn user. For functions that "control" data, such as cataloging, circulation, acquisitions, and serials, Unicorn uses a relational database. SIRSI explains that this ensures fast indexing and retrieval of data that lends itself to management in fixed length, highly structured fields. For the catalog and other resource databases, Unicorn uses a full-text database that is separate but linked to the relational database. This supports full-text indexing and retrieval performance which relational database structures do not support as well as do full-text databases. [3]

For libraries requiring customized access to Unicorn data, SIRSI provides an Application Program Interface (API) to all modules of the Unicorn system. The API allows libraries to create their own interactive input and output to the Unicorn system. All data elements of the integrated system can be retrieved and/or updated using these tools. SIRSI also provides other export and import tools to perform non-real-time updates to Unicorn.

Unicorn provides a broad suite of over 500 report templates and canned reports. Although not currently available for end-use, Structured Query Language (SQL) support for querying relational databases is inherent in the Unicorn system. It will be released for end-use starting mid-1998. The release will also support Open Database Connectivity (ODBC).

Search Engine

Unicorn's database retrieval capabilities are based on BRS/Search Engine from Dataware Technologies.[4] With the use of BRS/Search and Unicorn's integrated relational and full-text databases, every

word in a library's bibliographic records is fully indexed and searchable. Users can search using Boolean operators and can employ search strategies using truncation, wildcard searching, and word adjacency and proximity on any word or combination of words in a bibliographic record. Users can also highlight a word or phrase in a record and use hyperlinking to generate a search on the selection.

Network
Communications between Unicorn clients and servers can be via serial connection or a network connection such as Ethernet or TCP/IP.

Unicorn Computing Environment

Architecture	Three-Tier Client/Server
Operating System:	
Client	Windows, Macintosh, or UNIX
Server	UNIX: IBM AIX, HP-UX, Sun Solaris, Digital UNIX, NCR UNIX System V, SCO UNIX, Intel Solaris
Database Management System	RDBMS: Informix
Search Engine	BRS/Search (Dataware Technologies)
Hardware:	
Client	Character client: minimum of 80286 processor, 640KB RAM Windows client: minimum of 80486 processor, 16MB RAM, 5 MB hard disk Macintosh client: 68040 processor, 8 MB RAM, 5 MB hard disk WebCat client: Any workstation that can support a Web browser
Server	IBM RS/6000, HP-9000, Sun SPARCstation, Intel servers Minimum 64 MB RAM Minimum 2 gigabytes disk

Standards
SIRSI fully complies with Z39.50 (Level 3—1995), which is integral to the Unicorn catalog. Unicorn supports Z39.2 (USMARC). For Electronic Data Interchange, SIRSI has adopted the EDI ASC X12 standard and is developing capabilities under EDIFACT.

The Unicorn system was originally designed for Year 2000 compliance, and SIRSI tested the system to ensure the Y2K functionality works properly. Dates in Unicorn are based on the Julian date system which converts each date to a unique number. Unicorn also stores year information as four-digit values, so records dated December 31, 1999 will be followed by records dated January 1, 2000.

Security
Unicorn supports multiple levels of security. The system assigns a profile for each user which defines the commands that the user can execute. There are no pre-set security levels, and no limit on the number of user profiles. The number of variations in command security is limited only by the number of possible combinations of commands and objects within Unicorn. In addition, each workstation may be set up to perform any set of commands specified by the system administrator. Password security may be established. For a higher level of security, SIRSI offers Kerberos compatibility for secure user authentication.

Interface Design
SIRSI offers a variety of user interfaces to Unicorn:

- Graphical interfaces in the form of Macintosh and Windows clients.
- WebCat, a Web OPAC interface that supports users with any standard Web browser.
- A host-based DOS character interface to support dial-in terminal access.

The interface designs are consistent across all Unicorn modules. All Unicorn interfaces are designed to operate with the minimum number of keystrokes and menus to ensure users can access the system efficiently. Hyperlinking and keyboard entry are both available for searching the system.

Technical Support
SIRSI staffs a help desk accessible by toll-free phone number. The help desk staff operate with the goal of providing quick-answer service for technical problems. Their philosophy is that the library system is mission-critical and needs to be kept up and running consistently.

Training and Documentation
Unicorn documentation is fully integrated into the software so that support is available to users and staff online. Context-sensitive help screens are available for each command that can be issued at a workstation. Help screens include step-by-step instructions and sample searches for basic searching.

SIRSI provides training on implementation and use of Unicorn modules. SIRSI also provides consulting and training on the use of the API and on advanced system administration topics, such as database and log file handling. With this knowledge, library technical staff can extract information from the Unicorn relational database and build customized transactions with the API.

Planned Future Releases
SIRSI provides one regular release of Unicorn per year. Beginning with Unicorn 98, SIRSI changed from release numbers to year designation (Unicorn 98 would have been Release 10 under the previous designation). Unicorn 98, scheduled for release in February 1998, integrates WorkFlows (a Windows 95/NT client to guide users through library tasks and to redesign workflows for greater efficiency). SIRSI reports that SQL support for querying the databases is under development.

Much of the development currently underway at SIRSI relates to support for emerging standards. SIRSI is working on support for EDIFACT for exchange of electronic acquisitions and serials data. The company is a member of the NAILLD Interlibrary Loan Protocol Implementors Group (IPIG), which represents a commitment to implement the ISO interlibrary loan protocols 10160 & 10161. [5] Another

Unicorn Functions Availability

Function	Status	Availability
Acquisitions	Unicorn98	Now
Cataloging	Unicorn98	Now
Circulation	Unicorn98	Now
Electronic Reserves	Unicorn98	Now
Interlibrary Loan	Future	Future
Media Booking	Unicorn98	Now
Serials	Unicorn98	Now
OPAC		
Interface to CD-ROM Server	Unicorn98/ InfoBASE	Now
Z39.50 Gateway Search	WebCat/Information Gateway	Now
Full-Text Retrieval	Unicorn98	Now
Full-Text Search	Unicorn98	Now
Graphical User Interface	Unicorn98	Now
Multimedia Retrieval		
Images	Unicorn98/WebCat	Now
Audio	Unicorn98/WebCat	Now
Video	Unicorn98/WebCat	Now
Bibliographic Records Import/Export	Unicorn98/ SmartPORT	Now
Authority Control Import/Export	Unicorn98	Now
Standards Compliance		
Z39.2 (MARC)	Unicorn98	Now
Z39.50 (Level 3—1995)	Unicorn98	Now
EDIFACT	In development	1998
Unicode	In development	1999
Year 2000 Ready	Yes	Now

long-term development project at SIRSI is in the area of supporting multilingual capability in Unicorn through support of Unicode. This product will be tested in 1998, with full release expected in 1999.

ADAPTING UNICORN TO LIBRARY NEEDS

Overall Adaptability

Unicorn is a highly configurable system which can be adapted to the policies and procedures of a library without the need for programming expertise. Management tools included with the system give libraries flexibility in implementing policies and maintaining security. Unicorn's policy generator can display, create, and modify the parameters that control all library-defined policies for transactions as well as system policies. SIRSI's Administrative Interface allows library management to specify and change library policies at any time. Multiple library systems, such as consortia and libraries with multiple branches, can share a host computer for Unicorn while retaining independence of operation and policy setting. As mentioned earlier, SIRSI provides an API to all modules of the Unicorn system and training on the use of API.

Support for Effective Workflows

In general, SIRSI's philosophy behind Unicorn is to support libraries in doing their work with the fewest extra keystrokes and the least data entry. The goal is to support library staff in making use of their intellectual capacity. To do so, Unicorn offloads more routine, repetitive work to the system and provides standard data interfaces and import/export procedures.

Data Interfaces: SIRSI supports all USMARC formats for import and export of bibliographic and authority records.

SIRSI has developed a UNIX-based transaction manager for Unicorn to handle EDI X12 data transmissions. Libraries using SIRSI's X12 Transaction Manager can execute EDI transactions using UNIX-mail or FTP, without needing a Value Added Network (VAN). In addition, EDIFACT is currently under development and testing with book vendors Yankee Book Peddler and Harrassowitz.

In a pilot project to help libraries streamline their cataloging workflow, libraries can use SmartPORT to search and capture OCLC MARC records directly into the Unicorn catalog, while at the same time updating their holdings on OCLC WorldCat to reflect their addition of the record. To enable this productivity tool, SIRSI has implemented the EXT 1.5 Database Update Extended Service capabilities of Z39.50 to allow Unicorn libraries to access OCLC's WorldCat. [6]

Local Processing: SIRSI takes the concept of streamlining work processes even further with its new WorkFlows client. WorkFlows is designed as an intelligent technical services workstation that uses scripting and interaction with the user to combine and perform repetitive tasks for the user. In doing so, WorkFlows frees the user to act in the role of the workstation's "supervisor," while concentrating on work that requires a human intellect and decision-making capacity.

In a related project under development, FasTracq is a special module for streamlining the acquisition and cataloging of materials. FasTracq is based on a concept being developed by Stanford University Libraries. Stanford has enlisted three acquisition vendor partners and has coordinated and developed

EDI transactions with these vendors. Stanford has developed prototype WorkFlows wizards to aid librarians in managing the FasTracq technical services. SIRSI will complete the prototype wizards and add others to provide a complete module, which will be offered to all Unicorn customers.

Migration/Transition: Any product capable of exporting records in standard MARC bibliographic or authority format to a file on a workstation can be used as a source of records to be loaded to Unicorn. Unicorn includes a Bibliographic Record Loader to transfer these records into the library's database. SIRSI provides input formats for all objects used in Unicorn. Libraries can either provide data in those formats, or use SIRSI services to convert to those formats. Through this process, SIRSI can load not only MARC bibliographic data, but also non-MARC bibliographic data, as well as circulation, serials, acquisitions, and other data.

STRATEGY FOR NETWORKED INFORMATION

SIRSI's strategy for supporting networked information derives from the company's view that technology is leading libraries and users inevitably toward a single information environment. SIRSI plans to participate actively in this evolution. SIRSI's intent is to provide libraries a full service, reliable library management system, that also empowers end users both to tailor and to extend their information products to meet their special needs and goals.

SIRSI provides a number of resources for integrating a variety of information resources into the Unicorn environment. By using the InfoBASE option, Unicorn libraries can mount reference databases from commercial vendors on their Unicorn server. Users can then perform searches as they would in the library's local catalog. Through WebCat, a Web OPAC interface to Unicorn, users can be presented a unified offering of library resources. These resources include locally mounted databases, and access to Internet resources, including multimedia files, through searching and hyperlinking. When users click on a URL imbedded in a bibliographic record, WebCat links to the resource and launches the appropriate application to display photographs, images, full-text, and sound files.

Support for Emerging Data Formats
SIRSI fully adheres to all USMARC formats and also has user definable format tables for developing local record formats. Unicorn enables the library to store and search MARC and non-MARC based data formats within the same database. SIRSI also provides full support for the Dublin Core and for CENDI/COSATI, a set of formats used by U.S. government technical libraries.

SIRSI's Hyperion Digital Media Archive System, which supports the EAD format, can be used to create digital collections, either in a standalone application or integrated with Unicorn. SIRSI also provides full training, consulting, and project management services for digital archive creation projects.

Support for Electronic Payments
SIRSI does not currently support end user electronic payments for information, but anticipates future developments in this area.

PRODUCT DEVELOPMENT INFRASTRUCTURE

SIRSI points out that there are few examples, either in library systems or in the information industry, of software products that have had as extended a lifetime as Unicorn's. SIRSI attributes Unicorn's longevity and ongoing robustness to an early commitment made by SIRSI's founders. Unicorn development was viewed as a long-term, live operational experiment. The experiment was to produce a large-scale product that would have a lengthy lifespan. SIRSI believes the only way to satisfy its customers on both a short-term and long-term basis is to create a product that is high quality and stable enough to allow incremental changes without impacting the long-term direction of the product.

Product Development and Enhancement
To develop its products, SIRSI engages in a formalized feedback process with its user group. The process generally results in incremental enhancements to the Unicorn system. SIRSI also gets feedback from specific customers that are interested in seeing more advanced applications of technology. In addition, SIRSI gathers input from visits to customers and discussions at user group meetings or conferences. In this way the company can explore whether an idea is worth pursuing.

Development Partnerships and Technology Licensing
As mentioned earlier, since 1996 SIRSI has been collaborating with Stanford University and Carnegie Mellon University to develop WorkFlows, a user interface and work flow manager for Unicorn. In addition, several other SIRSI library customers conducted final usability testing prior to the release of WorkFlows. SIRSI and Stanford have also worked closely on development of Stanford's concept of FasTracq wizards for streamlining acquisitions processes.

Also as mentioned earlier, SIRSI licenses Dataware's BRS/Search for use as the Unicorn search engine.

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

SIRSI has acquired no other companies.

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SIRSI-Australia Pty. Ltd.
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Sales, Distribution and Support
SIRSI distributes its products through sales offices in the United States, Canada, Australia, and the U.K. In 1997, SIRSI partnered with a distributor in Saudi Arabia for coverage of the Middle East.

Company Executives
Jim Young, CEO and Chief Software Architect
Jacky Young, Chief Operating Officer
Mike Murdock, Chief Technical Officer

FINANCIAL STATEMENT

SIRSI did not release specific financial information. The company reported that it is in excellent financial condition. It has enjoyed 52 quarters of profitability and is wholly owned by its founders/employees. It has no debt, venture capitalization, or outside investors.

RELATED REFERENCES AND URLs

1. Of 625 installations at 1996 year end, SIRSI's customer mix was reported to be approximately 13% public libraries, 38% academic libraries, 26% special libraries, and 21% schools, in "International Survey of Automated Library System Vendors: Integrated, Multi-User, MultiFunction Systems Running on Mainframes, Minis, and Micros that Use a Multi-User Operating System," *Library Systems Newsletter* 17, no. 3 & 4 (March and April 1997): 30.

2. For a detailed description of Unicorn characteristics, see William Saffady, "Vendors of Integrated Library Systems for Minicomputers and Mainframes: An Industry Report, Part 1 [SIRS Corporation]." *Library Technology Reports* 33, no. 2 (March/April 1997): 239-252.

3. For a concise overview of database management systems in library systems, see "Database Management Systems(DBMS)," *Biblio Tech Review*, (August 1997) available from http://wkweb3.cableinet.co.uk/biblio/html/databases.html#sql; accessed 23 December 1997.

4. Dataware Technologies home page: http://www1.dataware.com.

5. For more information about the North American Interlibrary Loan and Document Delivery (NAILDD) Project, see http://www.arl.org/access/naildd/naildd.shtml.

6. For more information about OCLC's Z39.50 Cataloging Service, see http://www.oclc.org/oclc/promo/10188/10188.htm.

Sources: Interviews with Jim Young, Unicorn product literature and system overview, and SIRSI Corporation Web site.

The Library Corporation (TLC)

SUMMARY

Innovation and customer service are strong themes at The Library Corporation (TLC). TLC has built its reputation on standalone cataloger workstations, cataloging support, and database processing services for small- to medium-sized public and academic libraries. With the introduction of the Windows NT, client/server based Library•Solution, TLC believes it is redefining the concept of integration. The system operates from a single database with multiple access points and is designed to be rich in features, high in efficiency, and low in maintenance. TLC claims that Library•Solution was the first NT library management system to reach the market. TLC has also assumed an industry leadership role in automating interlibrary loan workflows with its development of an ISO standards compliant interlibrary loan module, Library•Request. As TLC upgrades current customers to the new system, it expects to raise its profile among larger libraries and compete with other established vendors. Challenges facing TLC in the coming year include: delivering acquisitions, serials, and ILL modules to provide full functionality expected in the competitive library systems market; providing a high level of service to customers as they migrate to Library•Solution; and ensuring that development and support keep pace with marketing activities as TLC targets the new system to larger libraries.

THE LIBRARY CORPORATION (TLC)

URL: http://www.tlcdelivers.com

Ownership

The Library Corporation is privately owned and located in Inwood, West Virginia. Its co-founders are Brower Murphy and Annette Murphy. Annette Murphy serves as president and CEO.

BUSINESS DIVISIONS/UNITS

The sole focus of The Library Corporation is developing library software, and the company is structured around development, sales, and support. Most of TLC's approximately 110 employees are based at company headquarters in West Virginia. Seven small sales offices are located throughout the U.S.

PRIMARY PRODUCTS AND SERVICES

For years, The Library Corporation has been known primarily for its CD-ROM based cataloger workstations, BiblioFile and ITS. Over time, TLC has built on its strength in cataloging and expanded into support for resource sharing, Web access, and database processing services for libraries and library consortia. TLC's primary products and services (DOS, Windows NT and Web-based) are:

Library•Solution—a turnkey, fully integrated library system that uses Windows NT software, Intel compatible hardware, an Oracle database, and Internet linkage. Introduced in early 1997, Library•Solution will be the focus of this report.

Library•Request—an interlibrary loan system that uses Z39.50 and ISO 10160/10161 protocols to communicate and manage requests among participating libraries (expected to be in full release by summer 1998).

TLC•Partner—a new, fixed-fee outsourcing service which provides complete central site hardware and software, installed, managed, and maintained by TLC.

Net•PAC—access to the library's catalog via the World Wide Web. Net•PACs are maintained and managed at TLC's internet site 24 hours per day.

Site•Solution—a service that assists libraries in creating their own Web sites by providing graphics and an HTML editor, with hosting on TLC's dedicated servers.

BiblioFile and ITS—standalone cataloger workstations, BiblioFile (DOS-based on CD-ROM), ITS (BiblioFile Windows version), and ITS•MARC (BiblioFile on the Web). ITS•MARC offers Web-access to over 10 million MARC cataloging records. BiblioFile is a PC-based family of library automation products that includes cataloging, circulation, and public access catalogs and BiblioFile Ready Reference. BiblioFile is being supported but is no longer actively marketed. TLC encourages DOS users to migrate to ITS.

Database processing services—preprocessing of MARC databases to be used in library and union catalogs. One-third of TLC's staff is dedicated to the company's MARC conversion and database preprocessing work, which has been a significant part of TLC's business for more than a decade. TLC processes over 4 billion MARC records per year.

PRIMARY MARKETS

The Library Corporation's market for over twenty years has been libraries that need cataloging support. Most of TLC's customers are small- to medium-sized public and academic libraries. TLC also serves K-12 school districts that do centralized catalog processing. TLC's current customer base consists of about 45% academic, 45% public, and 10% school libraries.

In 1985, TLC introduced its PC-based library automation system, BiblioFile, which included a CD-ROM public access catalog and a PC-based circulation system. Both work in conjunction with the cataloging system. TLC reports that it has 1,189 BiblioFile Cataloging users and 1,212 libraries using BiblioFile PAC. With the introduction of Library•Solution, the company's first priority is to convert its existing customer base for BiblioFile to the new NT-based integrated system.

As of January 1998, TLC had 79 libraries with signed contracts for Library•Solution in various stages of installation. The most recent contracts with the Libraries Division of the West Indies and the University of Malawi took Library•Solution into the international market. The December 1997

Library•Solution client list shows 20 technical institutes. The largest system to date (January 1998) is a public library with seven branches and over 100,000 titles.

OVERALL STRATEGY

The Library Corporation's strategic objective is to provide outstanding technology and exceptional service to libraries at an affordable price. With its tradition of developing well-regarded cataloging tools, TLC has built a solid base of business among many mainstream libraries. TLC aims to upgrade this base to its new system and is looking at larger libraries. Innovation and customer service are strong themes at The Library Corporation.

Innovation

TLC considers itself to be an innovative technology company and claims that Library•Solution is the first NT-based library management system to reach the market. When it developed BiblioFile, TLC was also the first vendor to provide a CD-ROM application for libraries, and the company reports that this accomplishment has been acknowledged as the first commercial application of CD-ROM technology in the world. Other vendors have licensed TLC technology for use in their own library systems. For example, CARL Corporation licenses ITS for Windows and will integrate its technical service capabilities into the CARL System. TLC has assumed a leadership role in testing and demonstrating compliance with the ISO interlibrary loan standard. TLC reports that several vendors have licensed its interlibrary loan system. [1]

Customer Service

While it considers itself an innovator, TLC's director of sales and marketing, Gary Kirk, states that in the competitive library technology market, service—not just innovation—will differentiate TLC.

LIBRARY•SOLUTION

For The Library Corporation, an important component of the company's strategy is the new client/server system, Library•Solution, which TLC presents as the "system that redefines integration." TLC plans to continue working with current customers, but also believes that it will be very competitive with all of the library system vendors because of the marketplace popularity of NT-based systems.

TLC has had a number of early sales outside its traditional customer base and has found itself competing with Ameritech, Endeavor, and DRA. Library•Solution's first "paying customer" was a former NOTIS site. The company feels it is now starting to get the attention of libraries that might not have considered TLC in the past. With the introduction of Library•Solution, TLC expects its market share to increase.

Library•Solution Release 1 is now in general production. The basic package includes: authority control, cataloging/database management with Z39.50 client capability, public access catalog with access via the World Wide Web, and circulation. Also available is Site•Solution, TLC's Web site creation service for libraries. Currently in beta test are optional packages for acquisitions, serials control, and interlibrary loan (Library•Request).

The Library•Solution Approach
Library•Solution is a total replacement for TLC's older character-based system. Its goal is to be rich in features, high in efficiency, and low in maintenance. Library•Solution uses Windows NT software, Intel compatible hardware, an Oracle database, and Internet links. The public access catalog is entirely Web-based. The company discontinued the NT OPAC client shortly after release, because in TLC's judgment, the Web solution is the more sensible one.

LIBRARY•SOLUTION TOOLS/FEATURES [2]

Architecture
Library•Solution employs multi-tier client/server architecture. It makes use of the Microsoft NT Server operating system. According to TLC, the operating system is cross-platform transferable. All major library automation functions are integrated using a single database that contains bibliographic, patron, holdings, circulation, community information, authority, and statistical records. All modules are designed to be aware of activities performed by other modules and of the data available to them.

The operating system provides prioritized processing of jobs and issues operator messages. It provides for queuing and dispatching of input/output operations to provide concurrent multi-task input/output support. Library•Solution includes error-handling routines, allowing one task to recover or abnormally terminate while other processing continues, and it assures that operator intervention is kept to a minimum.

The system is currently scaled to handle up to 15 library sites, 1.5 million titles, and 250 workstations.

Search Engine
The Library•Solution search engine is TLC proprietary. The system supports keyword and Boolean searching of title, author, subject series, call number and other fields, utilizing "see," "see also," and other authority controls. It also provides for limiting search results by date, language, country, location, and material type.

Database Management System
Library•Solution uses the Oracle relational database management system (RDBMS), which runs on a single database server. The Oracle RDBMS and the application communicate via standard Structured Query Language (SQL) for accessing and updating the database. TLC selected Oracle because it is a well-known standard tool that has the confidence of the library marketplace.

Network
The system supports multi-protocol networking communications including DECNET, TCP/IP, and OSI and provides transparent protocol conversion. Library•Solution can be configured to connect to the Internet and to other libraries and services. The PAC module allows on- or off-site searching with any standard graphical Web browser (Microsoft Explorer, Netscape, Mosaic). Connections can be made available to high-speed dedicated services for access to data indexes and fulltext documents. The PAC Z39.50 client allows a user to search for materials in the collections of other libraries with Z39.50 server support for their catalogs. Searching non-Z39.50 server supported collections can be done over the internet via telnet, TN3270, or other proprietary search modes.

Library•Solution Computing Environment

Architecture	Multi-Tier Client/Server
Operating System:	
Client	Windows NT
Server	Windows NT; Microsoft SQL server
Database Management System	RDBMS: Oracle
Search Engine	Proprietary
Hardware:	
Client	Pentium 200MHZ 32MB of RAM 2GB of Disk Space Any computer with a graphical Web browser can be used to access the Public Access Catalog.
Dataserver	Single Site, up to 35,000 titles; up to 7 workstations: Pentium 200/233; 64MB RAM; 2GB SCSI hot-swap hard drives Up to 4 Sites, up to 175,000 titles, up to 100 workstations: Dual Pentium 200/233 ; 128MB RAM: 4GB hot-swap hard drives Up to 15 sites, up to 1.5 million titles; up to 250 workstations: Quad Pentium 200; 256 MB; 4GB hot-swap hard drives

Standards

Library•Solution complies with the following standards:

- NISO Z39.2-199X Information Interchange format
- NISO Z39.21-1988 Book Numbering (ISBN)
- NISO Z39.43-199X Standard Address Number Identification Code for the Book Industry
- NISO Z39.47-199X Extended Latin Alphabet Coded Character Set for Bibliographic Use
- NISO Z39.50-199X Information Retrieval Service Definition
- NISO Z39.58-199X Common Command Language for On-line Interactive Information Retrieval
- NISO Z39.63-199X Interlibrary Loan Data Elements
- NISO Z39.23 Standard Technical Report Number

- NISO Z39.69-199X Record Format for Patron Records
- NISO Z39.9-1979 International Standard Serial Numbering
- ISO 2709-1981 Format for Bibliographic Information Interchange
- ISO X.400 Message Handling Services standard
- ISO X.500 Directory Services standard
- ISO 10160 and 10161 ILL standards

The system design also complies with EDI standards issued by ASC X12 for ordering, invoicing, shipping, and claiming. TLC has implemented interlibrary with BER and EDIFACT coding and expects to leverage this work for implementing EDIFACT in Acquisitions. Library•Solution is Year 2000 compliant.

Security

Library•Solution provides protection for application, system, and data files through the use of passwords or other security measures so that information-critical functions cannot be performed without proper authorization. Access privileges for specific terminals are assigned locally, without TLC intervention. There are no restrictions to the number of terminals that can access any module so long as the Windows NT and Oracle operating systems licensed limits are not exceeded.

Once configured by the library, built-in security protection for software modules and sub-modules is transparent to the user. Password access is not necessary at each level of software access except when deliberately configured by the library. The library may set mandatory password routines. The system can be configured so that workstations do not display modules to which they do not have access.

Interface Design

The online public access catalog can be accessed by any standard Web browser. Other modules run under Windows-based graphical user interfaces residing on PC clients.

Technical Support

TLC provides full maintenance for both software and hardware for Library•Solution. Libraries can e-mail or call an 800 toll-free number to reach support desk staff from 8 a.m. to 8 p.m. EST, Monday through Friday. For additional coverage, TLC provides an answering service after-hours and on weekends to reach staff members on call during those times. An Electronic Customer Bulletin Board has been established for communications among TLC customers.

Software maintenance includes all software enhancements offered as part of the standard system to future prospective customers. TLC can perform software problem diagnosis and maintenance by dial-in, internet or network access. Remedial hardware maintenance for equipment is provided Monday through Friday, 8 a.m. through 8 p.m. (EST). TLC maintains an adequate supply of repair parts. Records of each remedial or preventive maintenance activity performed are maintained on TLC's library system network.

Training and Documentation

TLC provides training in all functioning subsystems, including regular maintenance and troubleshooting. TLC will provide user's training for personnel who manage the system. Complete system and applications documentation is made available when the system is installed. Software documentation is

available in both print and electronic format. Online, context-sensitive help is available to users in the PAC module.

Planned Future Releases

Because Library•Solution is new, all installed customers are on Version 1. As of January 1998, TLC has established a quarterly release schedule for enhancements; bug fixes are released immediately. Interlibrary loan (Library•Request) and the acquisitions and serials module were in beta test as of January 1998.

TLC's interlibrary loan (ILL) system, Library•Request, is an industry leader in ISO 10160/10161 compliance, and TLC was the first library system vendor to demonstrate its ability to exchange protocol compliant messages with another library system. TLC expects ILL to become an increasingly important component of library systems. To support this trend, TLC is working on what it calls the virtual catalog, whereby libraries can communicate with each other and exchange information desktop to desktop no matter where the information resides.

ADAPTING LIBRARY•SOLUTION TO LIBRARY NEEDS

Overall Adaptability

The Library Corporation tries to give flexibility in adapting the system to individual library preferences. The most adaptable of the modules is the Public Access Catalog. It uses a browser interface and can be designed to look however the library chooses. TLC provides a standard template and works with libraries to develop a look that they like. If the library has the expertise to do HTML editing or graphics, it has total flexibility on the interface side of the PAC. TLC does not provide APIs or access to source code.

Flexibility in the circulation module comes from the report generator, which allows libraries to develop customized reports. The circulation module in Library•Solution uses the same functionality as the previous DOS-based system. It has been developed over a long period of time and has great depth of functionality, according to TLC.

The cataloging module supports macros and templates and can be configured for card and label printing. Libraries can set up many different kinds of templates for original cataloging. The Z39.50 access allows search access from the cataloging modules to whatever databases are profiled by the library.

Support for Effective Workflows

Because the Library Corporation's historic roots are as a provider of cataloging services, TLC is attuned to workflow issues in technical services. The cataloging module has a depth of functionality designed to make it very flexible in conforming to local practices. Many of the workflow issues involve staff in the use of Windows-based products and Internet browser services. The majority of Library•Solution sites sold thus far are either replacing TLC's old system or have been using another older generation, text-based system. These migrations have required some changes in routines as library staff adjust to a different interface and operating system. TLC reports that these changes usually have been welcome, as the new interfaces are far simpler and more streamlined to use. TLC works closely with libraries

Library•Solution Functions Availability

Function	Status	Availability
Acquisitions	In beta	June 1998
Cataloging	Version 1.3	Now
Circulation	Version 1.3	Now
Electronic Reserves	Version 1.4	March 1998
Interlibrary Loan	In development	June 1998
Media Booking	In development	Nov. 1998
Serials	In beta	June 1998
OPAC	Version 1.3	Now
Interface to CD-ROM Server	Version 1.3	Now
Z39.50 Gateway Search	Version 1	Now
Full-Text Retrieval	Version 1.3	Now
Full-Text Search	Version 1.3	Now
Graphical User Interface	Version 1.3	Now
Multimedia Retrieval		
Images	Version 1.3	Now
Audio	Version 1.3	Now
Video	Version 1.3	Now
Bibliographic Records Import/Export	Version 1.3	Now
Authority Control Import/Export	Version 1.3	Now
Standards Compliance		
Z39.2 (MARC)	Version 1.3	Now
Z39.50	Version 1.3	Now
EDIFACT	Future	Future
Unicode	—	—
Year 2000 Ready	Version 1.3	Now

that are new to the concept of shared cataloging records, to emphasize that cataloging consistency and conformance to standards have an enormous effect on the quality of access to information.

An area where TLC is positioned to make a significant contribution to changing workflows in libraries is interlibrary loan. Library•Request uses ISO standard messaging protocols to communicate among libraries and between the library and national ILL clearinghouses such as OCLC. Library•Request's Z39.50 client allows library staff or patrons to search for materials in other library collections. Once the material is located, Library•Solution will send a request, using ISO protocols, to potential lenders according to the home library's established hierarchies. Hierarchies can be highly customized and altered at will by authorized staff. Library•Request tracks statistical information that is useful in collection management and in meeting copyright requirements.

Data Interfaces: TLC accepts MARC records from the online bibliographic utilities OCLC and RLIN, and nearly any other source of MARC-formatted records. The system supports electronic transfer of bibliographic records without changing or deleting fields in the USMARC format. Library•Solution detects duplicate records as they are loaded and retains them in a separate review file. The system supports full USMARC bibliographic records without length limitations and creates all necessary indices for retrieval.

The system maintains authority files in USMARC authority format. All fields in the USMARC authority records, including the fixed and variable fields, can be edited. The system accommodates authority records either generated in-house or loaded from external sources, including bibliographic utilities, the Library of Congress, and others.

Local Processing: Library•Solution supports the local creation and maintenance of bibliographic records. Records in the authority, patron, community information, holdings, and classification formats can also be locally created and maintained. The cataloging module interfaces with CD products (including TLC's BiblioFile and ITS for Windows), tape files, and bibliographic utilities. A Z39.50 client with a customizable profiler provides access to millions of MARC records from various sources, including RLG's RLIN database.

Pre-formatted screen templates are provided for local data entry and editing. The library can create any number of templates for its own use. Automatic error checking of local data entries for conformity to USMARC rules is a feature. Also included is TLC's Cataloger's Reference Shelf, a context-sensitive electronic library of MARC manuals and lookup tables.

Migration/Transition: TLC staff work with the library to establish USMARC standard field locations for storing local call numbers, local holdings, barcode information, and purchase information. Complete database services are available for loading the database, eliminating duplicate records, authority control, and creation of smart barcode labels. The system is compatible with all standard barcode symbologies.

Library•Solution accommodates batch loading of bibliographic and authority records from BiblioFile, ITS, and OCLC archival tapes into the database without changing or deleting fields from the USMARC records. The system can also accommodate bibliographic and authority record transfer between libraries to facilitate bibliographic database building.

STRATEGY FOR NETWORKED INFORMATION

The Library Corporation's strategy is to work with information providers to direct users of the Library•Solution public access catalog to various sources of information. TLC has no plans to develop complex accounting and tracking systems, preferring to leave that to the information providers.

As mentioned earlier, TLC believes the virtual catalog will become a more important part of library systems and is working on developments in this area. TLC is also promoting through its Website a service called "Libraries on the World Wide Web," an ambitious attempt to link all the world's virtual catalogs.

Library•Solution can support non-MARC data within the system as long as it is linked by a MARC 856 field in a MARC record.

PRODUCT DEVELOPMENT INFRASTRUCTURE

Product Development and Enhancement

The Library Corporation's executive management team takes an active role in the product development process. The management team includes the director of sales and marketing, the general manager, the director of research and development, and the finance/administration head, all of whom report directly to the president and CEO. At weekly meetings, senior management works as a team to formulate future development plans, examining information from customers, sales people, and other companies. In the words of Gary Kirk, direction also "comes from our own ideas about the way we think things should be done."

The technical infrastructure for product development is supplemented by product managers. The process has become tighter since the company began work on Library•Solution. The senior product manager for Library•Solution oversees the product managers for each different module within the system. Product managers play key roles in the prioritization of development, since they funnel requirements and priorities for product development from customers, sales people, RFPs, and support staff to R&D.

Development Partnerships and Technology Licensing

The Library Corporation is a reseller for Hewlett Packard, Dell, and Compaq. TLC licenses third-party technology from Oracle and Microsoft for use in Library•Solution.

TLC is currently involved in talks with a number of vendors about licensing Library•Request for their use as an interlibrary loan module within their integrated systems. As mentioned earlier, TLC has entered into a similar licensing agreement with CARL for ITS, TLC's Windows-based cataloging workstation.

Advanced Technologies

Library•Solution was developed using object-oriented C++ programming. TLC sees itself as taking a leadership role in the development of object-oriented databases and Windows NT applications for libraries. TLC's current R&D effort is most heavily focused on further development of Library•Request. The company is following development of Java and thin client technologies, but considers these to be

"moving targets." TLC has no immediate plans for utilizing them in Library•Solution. TLC estimates R&D spending at approximately 25-30% of its annual expenditures.

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

The Library Corporation has acquired no other companies.

CORPORATE ORGANIZATION AND OFFICES

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Sales, Distribution, and Support
TLC maintains seven sales offices throughout the United States.

Company Executives
Annette Murphy, President and CEO
William Woodsmall, General Manager
Gary Kirk, Director, Sales & Marketing
Mark Wilson, Director, Research & Development
Calvin Whittington, Director, Finance & Administration

FINANCIAL STATEMENT

The Library Corporation reported that 1997 revenues were approximately $11 million. The company projects 1998 revenues will reach close to $15 million.

RELATED REFERENCES AND URLs

1. Under the terms of its third-party vendor agreements, TLC is constrained from releasing the names of vendors who have chosen to license its ILL technology; however, TLC reports that 25% of the NAILLD IPIG (ILL Protocol Implementors Group) is using TLC's technology. For more information and current status of ARL's interlibrary loan project, see http://www.arl.org/access/naildd/naildd.shtml.

2. For a detailed description of Library•Solution characteristics, see Joseph R. Matthews, "Library•Solution," Library Technology Reports 33, no. 1 (January/February 1997): 73-82.

Sources: Interviews with Gary Kirk and Mark Wilson of The Library Corporation; TLC product literature and Library•Solution product description; and TLC Web site.

VTLS Inc.

SUMMARY

Commitment to quality and support for standards are strong themes at VTLS Inc. From its beginning as a university library system, VTLS Inc. has developed into an international company with approximately 440 library customers in 38 countries and in 17 languages. VTLS's worldwide customer base consists of all types of libraries, with an emphasis on larger libraries, library networks, and national libraries. With the development of its new client/server system, Virtua, VTLS's goal is to provide a "radically different" library system that provides easy access to distributed multimedia information for libraries anywhere in the world. VTLS believes that its combination of data management, multimedia, networking, and open systems design makes Virtua unique. Support for distributed, networked access to information is a core VTLS strategy for Virtua. Challenges faced by VTLS for the coming year include completing the Virtua serials and acquisitions modules under the International Standards Organization (ISO) 9001 process and successful migration of VTLS customers to the new Virtua system.

VTLS INC.

URL: http://www.vtls.com

Ownership

A private company, VTLS began as a library automation project launched by Virginia Tech in 1975. VTLS Inc. was established as a for-profit company in 1985.

BUSINESS DIVISIONS/UNITS

The entire focus of VTLS Inc. is on development, support, and marketing of its library management systems, VTLS and Virtua, and related library automation services.

PRIMARY PRODUCTS AND SERVICES

VTLS Inc. offers library management systems and services in four major groups: library software, record conversion services, multimedia and imaging services, and consulting services.

Library Software

VTLS supports and continues to develop its legacy library management systems, currently available as VTLS97, the latest release of the classic VTLS product, and Micro-VTLS, a PC-based system designed for smaller libraries. VTLS97 is being developed and supported primarily for current customers, although VTLS continues to make new sales of VTLS97 both domestically and internationally. VTLS will continue to support VTLS97 and reports that VTLS98 is in development and should be released in the first quarter of 1998. VTLS Inc. also continues to support many of its older releases including VTLS92

and VTLS94. Support for the VTLS89 product did not end until 1997, demonstrating the company's commitment to customers who are unable to advance to higher technology due to a lack of resources.

In 1996, VTLS introduced a third-generation client/server system, Virtua. The company's marketing emphasis in the U.S. is on promoting Virtua, which will be the focus of this report.

Record Conversion Services
Primarily to support migration to VTLS systems, the company provides record conversion services including: archive tape preprocessing, loading, and indexing; record loading for serials holdings and item records; authority processing services; loading of patron records; and union catalog record processing.

Multimedia and Imaging Services
VTLS offers comprehensive services for planning and managing digital imaging projects, including project planning and consulting, outsourcing services for scanning and storage, and indexing services. Turnkey project management or joint project management options can be selected by the customer in working with VTLS to create a digital library. Virtua, VTLS ImageManager, and Virtua-Web Gateway provide storage and access technology for VTLS digital library customers. VTLS has completed significant imaging projects for the Library of Virginia, the National Library of Medicine, and Princeton University Libraries. VTLS has been selected by the National Archives and Records Administration to participate in its multi-million dollar Electronic Access Project (EAP).

Consulting Services
VTLS provides a variety of consulting services to assist libraries in implementing its library systems. In addition, VTLS can assist in network implementations, retrospective conversion, and union database creation. And, VTLS offers APIs (Application Program Interfaces) for libraries to design their own interfaces to third party systems such as financial management systems and student accounts. VTLS will also work with a library to customize these interfaces for the library.

PRIMARY MARKETS

VTLS reported that it had approximately 440 library customers worldwide in 38 countries at 1997 year-end, including Micro-VTLS customers. [1] The company indicates that approximately 50% of its customers are academic libraries, 35% are public libraries, and 15% are special libraries. VTLS has consortia, national libraries, and other large government libraries as a particular focus, and numbers among its customers the national libraries of Latvia, Russia, Malaysia, Indonesia, Scotland, Finland, and Switzerland, as well as the National Gallery of Art, U.S. Supreme Court, National Agricultural Library, National Archives & Record Administration, and the National Library of Medicine. VTLS also has a number of academic consortia such as those in Finland and Poland. About half of VTLS's customers are in the U.S. and half are international. With the introduction of Virtua, VTLS aims at attracting an increasing number of larger academic and special libraries.

OVERALL STRATEGY

VTLS's overall strategy is to provide a library system that is highly adaptable and multilingual, thus capable of serving all types of libraries around the world, and that provides easy access to distributed multimedia information. In particular, VTLS believes libraries that have special workflow, language, or processing requirements will find Virtua attractive because it can be easily customized. VTLS hopes to use new technologies to help libraries become more efficient and to provide more unmediated services and support directly to patrons through the library management system. Commitment to quality and support for standards are strong themes at VTLS Inc.

Commitment to Quality
VTLS stresses that its ultimate corporate goal is to provide total customer satisfaction. To demonstrate its commitment to ongoing quality assurance, VTLS chose to work towards ISO 9001 standards compliance. Such compliance encompasses review and documentation of all quality elements affecting its products, from design and production, to installation and customer service. Effective September 1997, VTLS was approved for certification and registered as an ISO 9001 company. ISO 9001 certification is particularly important for companies doing business in European markets.

Support for Standards
VTLS has a history of supporting development of standards through active involvement in groups such as NISO, the Z39.50 Implementors Group, and the Coalition for Networked Information.

VIRTUA

VTLS developed its third generation system, Virtua, with the goal of creating a "radically different" system designed to automate a library in a distributed, multimedia operating environment. VTLS believes that its use of new technologies makes Virtua unique among library management systems. Competitive systems have been introduced or announced based on similar technology principles.

VTLS reported that pre-release versions of Virtua's OPAC, Cataloging, and Circulation would go into production in February 1998. The Virtua Web-Gateway product is already in production. At the time of this report, Serials and Acquisitions modules were in development with release planned after alpha and beta testing are successfully completed. VTLS reported that it had 27 contracts for Virtua installations as of January 1998.

The Virtua Approach
Key aspects of the VTLS strategy for Virtua include the company's approach to data management, software development, and network optimization.

Data Management: Virtua employs a relational database management system (RDBMS) and fully supports Unicode for storing all data so that multiple languages and scripts can be correctly represented and manipulated by the system. Virtua also utilizes what VTLS calls Data Warehousing. Warehousing separates frequently changed data from relatively more stable data to make data handling, backup, and recovery more efficient.

Software Development: The VTLS approach to systems design includes employing a three-tier client/server architecture. VTLS believes three-tier architecture supports efficient database and network performance. VTLS utilizes rapid development tools and object-oriented design in its software development.

Network Optimization: VTLS supports standard Internet network protocols. It has also optimized Virtua for ATM network applications requiring more bandwidth needed to support multimedia information delivery.

VIRTUA TOOLS/FEATURES [2]

Architecture
Virtua utilizes a three-tier client/server architecture, which distributes processing between the client and the server software. The first tier represents all forms of the client, including:

- Virtua proprietary GUI interface (runs on Windows 95 and NT, Mac, UNIX);
- World-Wide Web OPAC Gateway (standard Web browsers used as clients); and
- VT100 Terminal OPAC interface.

The second tier is the process server, which handles state transitions, time synchronization, and transaction management. The third tier is the database itself. The database can be distributed across multiple servers if necessary.

Essentially, the process server manages all interaction between the client and the database, and distributes the processing on both the client and the server. All portions of the server applications software need to run on the same server, with the exception of the Virtua-Web Gateway, which is usually mounted on an institutional Web server.

In this three-tier architecture, the client communicates with the process server via a Z39.50-compliant API; communication between the process server and the database occurs via a database warehouse API. In order to reduce the amount of data that must be stored in RAM on the client, the Virtua Client software establishes a temporary Paradox database on the client workstation whenever the Client is active. The Process Server ships data packets directly from the server database to this client Paradox database, where it is then retrieved and manipulated as necessary by the client itself in RAM.

To scale Virtua, additional servers can be added as needed. The current backlog of Virtua customers, which are academic, museum, public, and special libraries, range in size from 50,000 to 2,500,000 records.

Database Management System
Virtua uses the Oracle 7 Enterprise Server as the underlying RDBMS. Use of SQL-compliant database systems enables reporting via any standard SQL report writer application, as well as applications enabled for ODBC (Open Database Connectivity). VTLS has currently tested only the Oracle Data Query application against Virtua. In theory, any standard report writing tool should work for extracting data from Virtua.

Virtua uses a "distributed data warehouse" to distribute data seamlessly across more than one server. This allows the separation of stable data from frequently changing data. Stable data is data that does not get updated frequently, such as the majority of the bibliographic and authority records. Volatile data, such as new bibliographic records, indexes, and circulation and patron information, require frequent changes. Through the use of this data warehouse, Virtua conserves disk space and achieves enhanced system performance. According to VTLS, the Virtua approach to data management supports libraries in their need for systems to handle large volumes of data quickly and efficiently. VTLS reports that customers can expect disk space savings of up to 30 percent or more through the use of this Virtua technology.

Search Engine

Virtua's search engine is proprietary to VTLS. In addition to standard Boolean search strategies and operators (AND, OR, NOT, NEAR), Virtua supports adjacency and proximity searching, wildcards (single and multiple character), and multiple truncation options (left, right, and medial truncation). VTLS reports that these features are optimized through search engine capabilities licensed from Fulcrum Technologies.

Virtua Computing Environment

Architecture	Three-Tier Client/Server
Operating System:	
Client	Staff: Windows 95 or NT Workstation; OPAC: Windows 3.1, 3.11, 95, or NT
Server	UNIX: IBM RS6000/AIX, HP9000/HP-UX, DEC Alpha/Digital UNIX, Sun Sparc/Solaris
Database Management System	RDBMS: Oracle 7 Enterprise Server
Search Engine	VTLS Proprietary
Hardware:	
Client	Recommended configuration: 586/100 processor; 16 MB of RAM; 100 MB free disk space for staff workstation, 50 MB for OPAC
Server	IBM, DEC, Sun and HP servers supported

Network

Virtua uses the standard TCP/IP network communications protocol. Each client is connected in a stateless mode, in which the server application serves all the clients by sitting idle until the client makes a request. Upon a request, the server performs a function, provides the results to the client, and returns to an idle state. The server does not maintain a state, thereby allowing the client to control the flow of operations. In Virtua, because the process server ships data directly to the Paradox database on

the client workstation, the client/server connection can be cut when all data has been received by the client; further manipulation of the data can occur on the client with an infrequent need to request more data from the server.

In addition to supporting TCP/IP networking, Virtua also supports the Asynchronous Transfer Mode (ATM) protocol, which utilizes technology based on a switched network and a dedicated connection so that bandwidth is not shared. VTLS considers ATM a key technology for effective delivery of multimedia information containing music and full motion video, which require high bandwidths. Virtua is being optimized and tested for ATM networking.

Virtua's OPAC incorporates the Z39.50 (version 3) retrieval standard, functioning both as a client (to conduct searches of remote library catalogs) and a server (to accommodate remote users accessing the local catalog over a network such as the Internet). Virtua also uses Z39.50 internally for client/server communication, enabled by using a wide variety of proprietary VTLS extensions to the Z39.50 protocol. The generic record syntax (GRS)-1 is used for record types other than bibliographic (such as item records, acquisition records, circulation transaction records, etc.). The use of Z39.50 extended services enables record editing and updating via Z39.50 communications.

Standards

VTLS stresses its history of adopting standards and supporting their development. The company actively participates in the efforts of NISO, the Z39.50 Implementors Group, and the Coalition for Networked Information. VTLS is currently participating in NISO work on the Digital Object Identifier (DOI) initiative.

Among the numerous standards supported by Virtua are Z39.2 (MARC and national variants), Z39.50 (version 3), Unicode (version 2), and EDIFACT and ASC X12 standard for electronic data interchange. Virtua is Year 2000 compliant.

Security

Virtua requires a login to the system. The login and password, combined with the permissions for each user type, define what level of access to the system a user has. This security level includes such access permissions as views, subsystem access, and functionality.

Interface Design

The Virtua Client software is a graphical user interface to the system. The Client resides on Windows 95 workstations. Two versions of the Virtua client will be available. The Public version is designed for public activity and has imbedded Z39.50 capability. The Staff version is designed to support dynamic switching between the online public access catalog and other subsystems such as circulation, cataloging, or acquisitions and serials.

Technical Support

Direct day-to-day operational support is provided by VTLS customer services staff. However, all staff are trained to help customers if they are called upon to do so. In the United States and Canada, VTLS provides a toll-free support hotline for VTLS users. The same hotline is available to international customers, but it is not toll-free. Customer service librarians and analysts are available Monday through Friday, 8:00 a.m. to 8:00 p.m. (EST/EDT). A 24-hour emergency service is provided to assist customers after 8:00 p.m. VTLS also provides remote diagnostics and correction of problems via telnet,

on-site emergency services, and periodic update tapes with enhancements and corrections of software problems.

Training and Documentation
VTLS support services provides libraries an annual site visit. The site visit consists of two days per year of on-site services for any purposes designated by the library. Typically this involves additional training for new subsystems or for new staff. The visit can also be used for consulting services, diagnostics, system tuning, or implementation of new software or a new release. Depending upon these needs, VTLS will send either a librarian or a technical analyst to the site to provide these services.

Planned Future Releases
In 1998, Virtua plans to put into production the Virtua serials and acquisitions modules. Also in development is an automatic translation system for multilingual subject headings. This will allow for those patrons searching in one language, French for example, to find "hits" in other languages such as English or Spanish.

VTLS Inc. reports that its research and development is consistently working on new enhancements and releases to its software products, in addition to the research of new technologies.

ADAPTING VIRTUA TO LIBRARY NEEDS

Overall Adaptability
VTLS realized in beta testing Virtua that profiling the system was complicated, so it developed a Virtua System Client, which allows libraries to configure and profile the entire system through a graphical interface. The Client is designed to allow system managers to configure the system without needing programming expertise or knowledge of the data structures.

VTLS provides additional flexibility by making Virtua's client/server APIs and the warehouse APIs available to users. This permits access to the system so users can integrate Virtua with their other systems such as accounting, finance, and personnel systems. In addition, the system supports ease of maintenance by automatically downloading and configuring each client to the latest version of the software upon logging in.

Support for Effective Workflows
Data Interfaces: Virtua supports MARC import and export for bibliographic and authority records from any source if the record is in MARC format and the communication protocol supports Z39.50. As noted earlier, serials and acquisitions modules are not yet in general production. In the forthcoming acquisitions module, Virtua will support EDIFACT transaction sets for orders, claims, and invoices as defined by BISAC and SISAC. VTLS does not use a third party software for EDI. All of the EDI development is done in-house and will be functional when serials and acquisitions are in general release.

Local Processing: Virtua's clients use enhanced windowing capabilities, allowing several documents to be open on the screen at one time. Similarly, because of Virtua's stateless client implementation, multiple unique search sets can be active simultaneously. The user can switch back and forth between sets at will with a click of the mouse button. Groups of records are sent to the client in a "folder and tabs" format to facilitate working with documents and records.

Migration/Transition: To assist libraries in migrating to Virtua from other systems, VTLS has developed a suite of software programs. VTLS provides a migration path from VTLS's legacy system. VTLS has designed tools to move data from several older library systems to Virtua's environment. Migration tools are now available for migration from NOTIS, DOBIS, and LIBIS systems. Tools are being developed for migration to PALS. VTLS migrates bibliographic records, authority records, vendor files, holdings, circulation and patron records, and transaction logs.

STRATEGY FOR NETWORKED INFORMATION

Support for distributed, networked access to information is a core VTLS strategy for Virtua. The company's goal for Virtua was to design and develop a new system to address what it saw to be key marketplace trends: a rapid shift to digital collections, increased network access, and a movement to globalization. VTLS describes Virtua as the first system designed specifically to handle multimedia applications in a distributed network environment.

Support for Emerging Data Formats
VTLS has been working with multimedia technology for several years, focusing on data management, network, and storage and retrieval capabilities. Virtua supports integrating multimedia databases with a bibliographic database utilizing the 856 MARC tag. By linking bibliographic records to external multimedia files, libraries can create descriptive cataloging records in Virtua. With these records, users can search the OPAC and retrieve the contents of image, sound, video, and other types of digital files that can be accessed over the network (including remote Internet resources). As mentioned earlier, VTLS also does turnkey imaging projects to create digitized multimedia databases for libraries.

Support for Electronic Payments
Virtua does not currently support individual payment transactions for document delivery or other commercial information. It does allow for payment of acquisitions via credit cards and debit cards. VTLS reports that additional functionality is currently under development.

PRODUCT DEVELOPMENT INFRASTRUCTURE

Product Development and Enhancement
VTLS reports that ISO 9001 has had a tremendous impact on the way the company operates. In preparing for certification under the ISO 9001 guidelines and the TickIT scheme for software development, VTLS was required to review and document its methods for design specification, development, documentation, testing, service, and support of all of its software products. During this process, the company scrutinized the current methods and procedures for every activity that fell under the realm of ISO 9000. While doing so, VTLS determined that some aspects of its current design documents for Virtua did not closely follow the TickIT scheme. In order to obtain its goal of total customer satisfaction, VTLS stopped development in several key areas in order to further define and document workflow processes. VTLS believes these design checks and eventual design changes, with clearer documentation, will result in a more efficient, rapid and successful development cycle in the future.

Virtua Functions Availability

Function	Status	Availability
Acquisitions	In development	1998
Cataloging	Available	Now
Circulation	Available	Now
Electronic Reserves	Available	Now
Interlibrary Loan	In design	Future
Media Booking	In design	Future
Serials	In development	1998
OPAC	Available	Now
Interface to CD-ROM Server	Available	Now
Z39.50 Gateway Search	Available	Now
Full-Text Retrieval	Available	Now
Full-Text Search	In development	Future
Graphical User Interface	Available	Now
Multimedia Retrieval		
Images	Available	Now
Audio	Available	Now
Video	Available	Now
Bibliographic Records Import/Export	Available	Now
Authority Control Import/Export	Available	Now
Standards Compliance		
Z39.2 (MARC)	Available	Now
Z39.50 (version 3)	Available	Now
EDIFACT	In development	1998
Unicode (Version 2)	Available	Now
Year 2000 Ready	Available	Now

During the ISO 9001 process, VTLS also reworked and strengthened its quality control and testing procedures. In rededicating itself to quality control, VTLS made the statement that no product, including Virtua, would be released until the quality system had thoroughly given its seal of approval. VTLS feels that any delays this may have caused in Virtua's release will be repaid by customers' satisfaction with the final product. The release of VTLS97 is VTLS Inc.'s first software release fully designed, developed, and tested under ISO 9001 procedures. The company reports that the release of VTLS97 has been well received among its customers and is considered by many to be the best designed and most maintenance-free release that VTLS has ever produced.

VTLS determines development priorities based on four factors:

- marketplace analysis and needs, particularly as expressed through VTLS customers;
- internal R&D focus on identifying new and useful technology tools (VTLS reports that it allocates 30% of revenue to research and development);
- structured customer input process, in which user groups log and prioritize enhancement requests; and
- custom development requested to meet a particular need.

Virtua client software is developed with Delphi, a rapid application development tool based on Visual (object-oriented) PASCAL. The Virtua server is written in C and Embedded Structured Query Language (SQL). Pre-defined reports are developed using Oracle Reports.

Development Partnerships and Technology Licensing

VTLS has development partnerships with The University of Kansas and Virginia Tech, who provided input to Virtua's design and implementation. In addition, VTLS reports that it works with development partners around the world to develop and test Virtua.

VTLS Inc. continues to involve itself with development projects with its customer libraries. The company finds that while working with customers to solve complex problems and in developing solutions to fit their specialized needs, it can apply its new technologies to products and services for all of its libraries. One example of a current development partnership is with the Library of Virginia Digital Library Initiative. This partnership is evaluating the development of technology for an intelligent document retrieval application for maps. This "map-based" searching tool would be implemented along with the other map digitization projects that VTLS and the Library of Virginia are developing.

ACQUISITIONS AND STRATEGIC PARTNERSHIPS

VTLS has acquired no other companies.

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Sales, Distribution, and Support
VTLS's sales are handled by a geographically aligned sales organization that works in close cooperation with distributors and partners. The VTLS sales force includes field sales representatives teamed with inside customer account executives. In addition to its corporate offices in Blacksburg, Virginia, its European offices in Finland, Poland, and Spain, VTLS supports affiliates in eight other countries: Australia, Brazil, Germany, Greece, Kuwait, Malaysia, Thailand, and Switzerland.

Company Executives
Vinod Chachra, President
Jack Bazuzi, Vice President and Director of International Operations
George Nichols, Vice President for Finance
Ari Palttala, Vice President for Marketing and Sales

FINANCIAL STATEMENT

VTLS reported that annual revenues are in the range of $5 to $10 million and increased 32% from 1996 to 1997. Fiscal year ends: June 30.

RELATED REFERENCES AND URLs

1. VTLS was reported to have 268 VTLS system installations at 1996 year-end in "International Survey of Automated Library System Vendors: Integrated, Multi-User, Multi-Function Systems Running on Mainframes, Minis, and Micros that Use a Multi-User Operating System," *Library Systems Newsletter* 17, no. 3 & 4 (March and April 1997): 32.

2. For a detailed description of Virtua characteristics, see William Saffady, "Vendors of Integrated Library Systems for Minicomputers and Mainframes: An Industry Report, Part 2 [VTLSInc.]," *Library Technology Reports* 33, no. 3 (May/June 1997): 359-370.

Sources: Interview with VTLS President, Vinod Chachra; VTLS product literature and Virtua specifications; and VTLS Web site.